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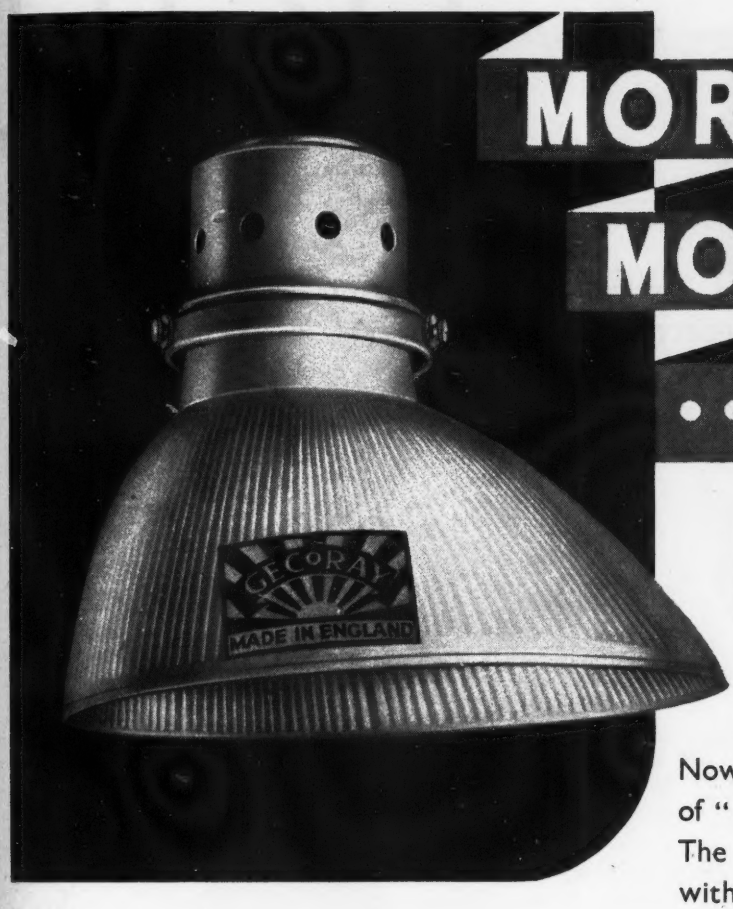

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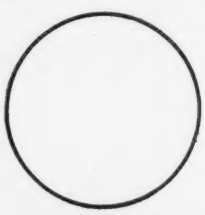
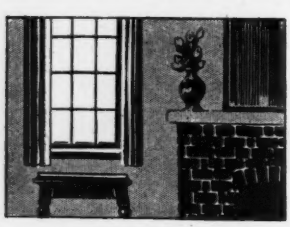


1,000 FOOT CANDLES

When the June sun is shining brightly the light in the shade of a tree is 1,000 foot candles.

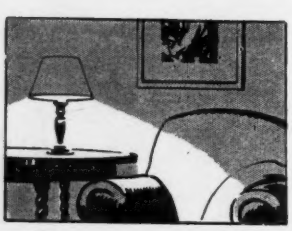
500 FOOT CANDLES

When the same June sun is shining, the light in the shade of a porch is 500 foot candles.



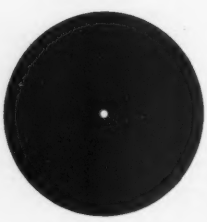
200 FOOT CANDLES

When the June sun is shining, the light a few feet inside a window is 200 foot candles.



5 FOOT CANDLES

After the sun has gone down, the light in the average living room is less than 5 foot candles or 1/2,000th of sunlight.



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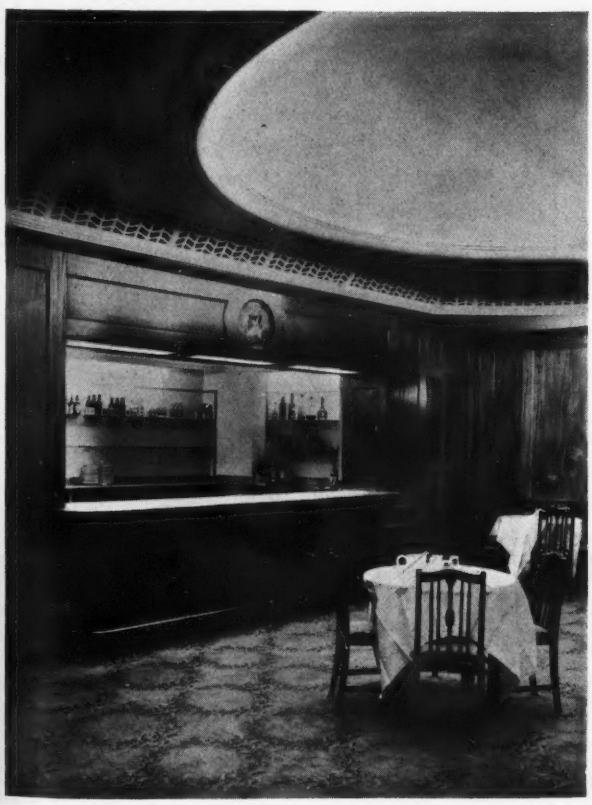

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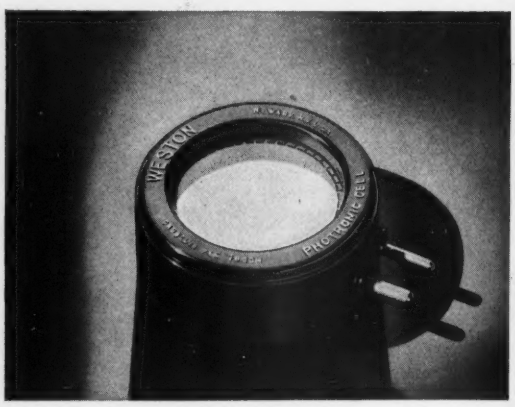

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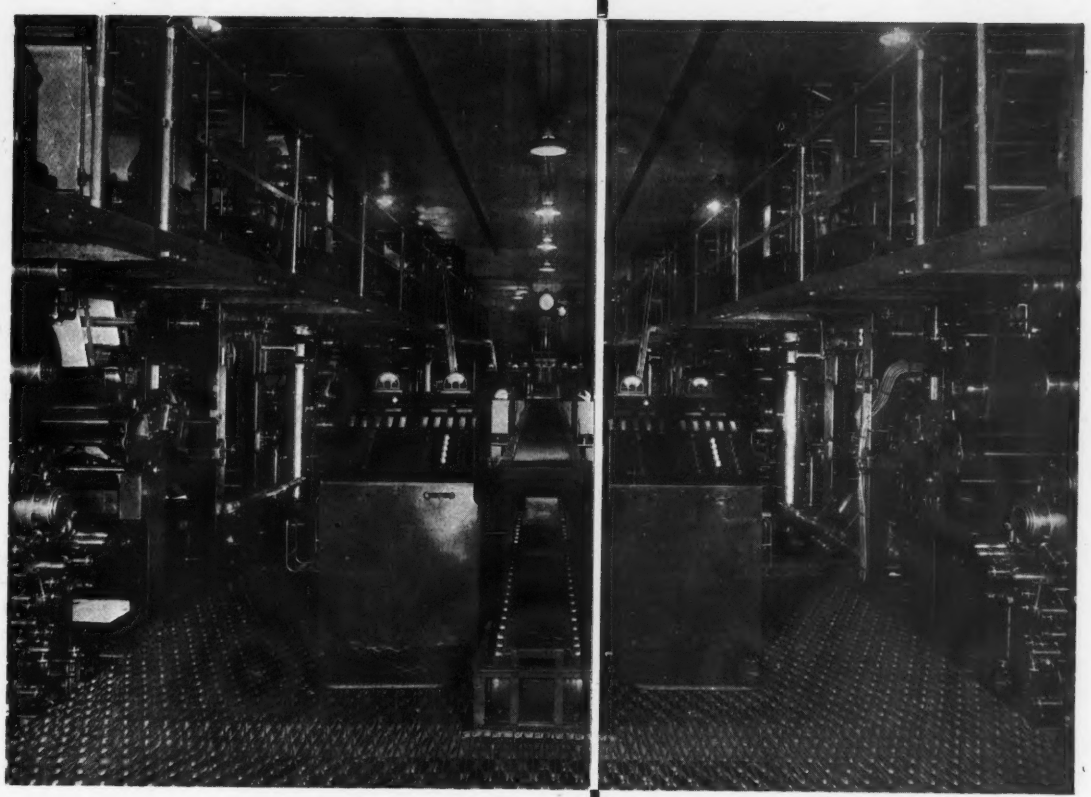

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Light and Lighting

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Ten Years of Architectural Lighting — and its Results

ARCHITECTURAL Lighting, which forms the subject of an article by Mr. Sutherland (p. 368), is just ten years old. Dr. N. A. Halbertsma has recently analysed its influence and effects.* Let him tell the story.

Architectural Lighting has:

(1) Brought architects and lighting experts together—developed co-operation previously sought in vain for at least twenty-five years.

(2) Contributed in many ways to progress in lighting, both indoors and outdoors.

(3) Given a powerful impetus to the production of lighting installations free from glare.

(4) Created a revolution in lighting fittings and revealed a way out of the maze of conservatism in design.

(5) Eliminated the idea that efficiency is the *sole* basis of judgment of lighting installation.

(6) Had a material influence on the development of architecture.

(7) Enabled the appearance of a city by night to be profoundly altered.

(8) Provided the only aesthetic solution of the problem of luminous publicity in cities.

(9) Aroused keen public interest in lighting.

(10) At last achieved the desired condition that the necessary expenditure on lighting a building is considered at the beginning and not at the very last!

*Die Lichttechnik (Elek. u. Masch 54 No. 27, 1936)

I.E.S. Local Meetings—A Visit to Gatwick Aerodrome—Seeing in Tungsten, Mercury, and Sodium Light—Science and Electric Lamps—Lincoln's New Lighting—New Lighting at King's Cross—Illumination and Scholarship.

I.E.S. Local Meetings

The I.E.S. Session in London has opened well, and it is encouraging to see how quickly, this year, the various informal local centres have got into their stride. In Manchester—which may be termed the senior of these local gatherings—there was a meeting on October 20 at which various exhibits illustrating progress were shown. Mr. R. O. Ackerley, accompanied by Mr. T. E. Ritchie, travelled up from London to give the introductory address. Subsequently (November 24) there was an address by Mr. R. O. Sutherland on Architectural Lighting.

In Glasgow, following a paper by Mr. L. J. Davies on Electric Discharge Lamps, there was a very successful meeting, attended by an audience of over 200, at which the President (Mr. A. Cunnington) gave an informal talk on "Milestones in Illuminating Engineering." A good array of exhibits, in which quite a number of those who had shown things in London again helped, was arranged.

In Dublin a similar "Progress" meeting is projected, and in the meantime one is glad to see that there have already been several gatherings. At the first of these, on October 13, Mr. F. X. Algar presided, and Mr. H. Lingard presented a paper on "The Science of Seeing."

We should like to urge readers to bring these local organisations to the notice of friends in the various localities. (The names and addresses of the honorary local secretaries are given in the official I.E.S. List of Members.)

Visit to Gatwick Aerodrome

A pleasant event on November 17 was a visit to Gatwick Aerodrome, in which about seventy members of the Illuminating Engineering Society and friends took part. The president, who led the party, had been largely responsible for the arrangements for the visit. On arrival the party had an opportunity of getting a preliminary view, by daylight, of the lay-out of the aerodrome and an opportunity of inspecting the landing ground, the hangars, where repairs are conducted, and the various floodlights. The party—split into two for the purpose of this preliminary inspection—were reunited at tea after which Mr. S. A. Gordon, the secretary and manager of the aerodrome, explained some of its leading features and conveyed a welcome to the party. Details of technical equipment were also given by Mr. G. H. Wilson and Dr. W. M. Hampton. After the president had expressed the thanks of the visitors, a selected group was admitted to the control room (in which there was only room for a privileged few!) and a good opportunity was provided for everyone to study the effect of the floodlighting and of such devices as the luminous direction sign (controlled from the tower) which helps to guide descending planes to their allotted stations.

Seeing in Tungsten, Mercury, and Sodium Light

This interesting and much-discussed question has been studied in detail in a paper by M. Luckiesh and F. K. Moss, recently presented before the American Illuminating Engineering Society and now reprinted in pamphlet form. It is, of course, difficult to announce unqualified decisions when so many factors are involved, but the researches do seem to support the belief that the differences in "visual effectiveness" of these three systems of lighting are not very great. Of special interest are the conclusions in regard to sodium light, which is judged to be somewhat better than light from the tungsten lamp in revealing detail of threshold size. But when objects far above threshold size are to be seen—as on the highway—the advantage is much less evident. Similarly, whilst sodium light appears to enhance relatively high contrasts, the effect seems to be in the other direction when low degrees of contrast are concerned. The speed of seeing a small object is again greater under sodium light than under tungsten light, but for larger objects there is little difference between the two illuminants.

Forthcoming Events.

Dec. 8th. Mr. Paul Freedman on **Low Voltage Neon.** *(General Meeting of the Illuminating Engineering Society, in the Lecture Theatre of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.);* **6.30 p.m.**

Dec. 17th. Mr. E. W. Murray on **Factory Lighting and Accident Prevention.*** *(Local Sectional Meeting of the Illuminating Engineering Society, at the Cadorna Restaurant, Glasgow).*

1937.

Jan. 5th. Mrs. M. Pender-Chalmers on **Home Lighting.** *(Local Sectional Meeting of the Illuminating Engineering Society, at the College of Technology, Manchester);* **7.15 p.m.**

Jan. 12th. Mr. J. W. Howell on **Some Important Considerations in Colliery Lighting.** *(General Meeting of the Illuminating Engineering Society, in the Lecture Theatre of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1);* **6.30 p.m.**

* *Repetition of paper read in London on Nov. 10.*

Science and Electric Lamps

We have before us a copy of Mr. C. C. Paterson's address before the British Association on the above topic. The subject-matter was in the main familiar to members of the Illuminating Engineering Society —Mr. Paterson himself has helped to make it so—but the demonstrations and experiments illustrating the various stages of progress in electric lamps were most skilfully contrived. He commenced by showing two lamps, of very similar appearance, but respectively utilising a filament and luminescent vapour. The former—the youngest descendant of Swan's first carbon filament lamp, yields just about ten times as much light for the same input of power. Mr. Paterson showed the audience in turn the effect of increasing temperature of incandescence, inert gases in the bulb, coiled filaments, and "coiled coil" filaments—the latter a miracle of skilful manufacture, using wire of a diameter which must be correct to within five-millionths of an inch. Of 3,775 turns in a spiral, not one must touch its neighbour, though there is only a space less than the thickness of a cigarette paper between any two turns. Equally striking was the description of lamps using sodium, neon, and mercury, and of the very latest high-pressure lamps. The water-cooled variety which attains 30,000 candles per sq. cm. was shown, and it was explained that a limit of 150,000 candles per sq. cm.—comparable with the brilliance of the sun itself—*can* be attained—but only for a few minutes or even seconds. The possible uses of fluorescence to modify the colour of light from such lamps was touched upon, though the lecturer implied that it was unlikely that even the latest and most compact electric discharge lamps will displace the eminently simple tungsten filament from the field of domestic lighting—at least for some little time to come.

Lincoln's New Lighting

The picture above shows the new lighting of Ruskin-avenue, Lincoln, one of the most important connecting roads in the city. Under the direction of the City Electrical Engineer, Mr. F. Newey, fifteen Ediswan Northbury lanterns, equipped with 400-watt Escura electric discharge lamps, have been installed. A feature of this lantern is the simple and adjustable reflector system, giving full control of the light in both horizontal and vertical planes. The angle of the beam can thus be varied so as to obtain even illumination on either upward or downward gradients. The picture furnishes a good example of the part played by a background of even high brightness in promoting visibility and causing figures and objects on the roadway to be revealed in silhouette.

New Lighting at King's Cross

The latest development in the modernisation scheme of the London and North-Eastern Railway is the complete relighting of their goods depot at King's Cross station. The new installation, which has been carried out by the Gas Light and Coke Company, consists of 248 "Littleton" lamps by William Sugg and Co., Ltd., of London. It replaces 187 old pattern lamps that had been in use for many years.

Many important goods trains, including the world-famous 3.40 p.m. Scotch Express goods train, which runs to Glasgow, Edinburgh, and Aberdeen, are loaded from the depot.

The lamps have been so arranged on the low level as to light the interior of the wagons and speed up loading and unloading. On the high level, where work is carried on without artificial light until nightfall, the existing lighting installation has been brought up to date and enlarged. We understand that the illumination is more than five times its former value. The above picture gives a good impression of the effect, and the fact that it was possible to include figures in the view is a testimony to the brightness of the lighting.

Illumination and Scholarship

The possibility of getting direct evidence of the benefit of better lighting in schoolrooms was discussed in some detail by the joint committee appointed by the Illuminating Engineering Society in this country, which reported in 1931. Some tentative experiments were made but the difficulties appeared somewhat formidable. In this connection, an experiment described by Mr. Willard Allphin in the "Transactions of the American Illuminating Engineering Society" (September, 1936, p. 739) is of great interest. Two similar classrooms were equipped, one with four 150-watt enclosing globe fittings yielding four to six foot-candles, the other with six 500-watt indirect fittings furnishing twenty foot-candles (a value which was maintained by a photronic relay when daylight fell below the limit). The experiments proceeded from November to June. Careful records of work were kept and special efforts to avoid influence by extraneous factors were made. According to the author, the improved performance by pupils in rooms with the better lighting was unmistakable and consistent. The gain in improvement was as much as 28 per cent. in reading and 10 per cent. in general achievement. Following this encouraging experiment it is proposed to initiate a large-scale test over a number of years. In the meantime, the result certainly "gives one furiously to think," when it is recalled that the "bad lighting" in this case was of the order of four to six foot-candles—a value approximating to that suggested in the 1931 I.E.S. report as the desirable minimum and certainly not attained, even now, in many schools.

Factory Lighting and Accident Prevention

by

E. W. MURRAY, A.M.I.E.E.
(H.M. Engineering Inspector of Factories).

An Example of Modern Overhead Lighting. The factory of Higgs Motors Ltd., Birmingham, lighted by 150 w. lamps in Benjamin Saaflux R.L.M. reflectors, mounted 12 ft. above floor. Illumination 11.5 foot-candles.

Education in Illumination—Daylight and Artificial Light Compared—Special Requirements of Certain Industries — Conditions of Shadow — Imperfect Lighting and Accidents—Very Fine Work—Low Voltage Lighting—Electrical Accidents.

A very practical paper on factory lighting was presented by Mr. E. W. Murray at the joint meeting of the Illuminating Engineering Society and the Institution of Engineers in Charge on November 10. As a Factory Inspector, Mr. Murray has a keen eye to methods of demonstrating vital points, sharpened by his experience at the Home Office Industrial Museum. The lecture was illustrated by a series of lantern slides, many of them conveying useful lessons, and by demonstrations of such points as the effect of glare, the influence of illumination on speed of vision, low-voltage lighting, and right and wrong methods of wiring lamp holders. In opening the discussion, Mr. Foster, a vice-president of the Institution of Engineers in Charge, recalled the historic paper on "The Province of the Illuminating Engineer," read before that Institution by Mr. L. Gaster in 1907. This was the starting point of the illuminating engineering movement in England.

In his opening remarks, Mr. Murray emphasised the fact that industrial education in illumination proceeds slowly. There has been rapid progress in cinema and theatre lighting. It is only a few years since shopkeepers came to realise that the public, when viewing their windows, could not see the goods if they were blinded by the lights in the window. Now much higher illuminations, but from concealed lamps, are usual. Improvement has spread, more slowly, into the home. This follow-my-leader process eventually takes root in the industrial field, but it seems to require a longer period of time. The usual complaint when improvements in illumination are suggested is that there is no money to spare. But the same response is frequently made to any suggestion for improvements. It is only by mentioning the matter a sufficient number of times that any advance can be secured!

In presenting the claim for good illumination it is, however, necessary to be sure of one's ground. One should try to see clearly the objects which operators are expected to see, and under the worst conditions. A casual glance is useless. Remember that the worker must go on hour after hour. Remember, too, that no amount of illumination will correct defective vision. One should adapt one's scheme to normal vision or vision corrected by glasses to this condition. Later in the paper Mr. Murray recurred to this topic, pointed to the reports of Mr. H. C. Weston on certain forms of very fine work (e.g., the examination of artificial silk or the fine wires used in wireless components) which involve bringing the objects very near to the eyes. In such cases magnifying lenses are necessary to avoid undue fatigue of vision.

Importance of Maintenance.

There are a number of published reports that afford guidance in regard to values of illumination, such as that recently issued by the Illuminating Engineering Society and the reports of the Departmental Committee on lighting in factories and workshops. In judging such data due regard should be paid to the wide difference between initial values in a new installation, and those found in factories when ageing of light sources, discolouration of reflectors, and deposits of dirt on lamp fittings, and surroundings have all contributed to loss of light. Here, again, the author pointed out that many manufacturers do not yet realise the truth of the saying that "soap and water are cheaper than the energy required to provide light." They are often amazed at the increased illumination after thorough cleaning of the light units. In some cases light-meters are purchased and handed over to the managers of the different shops, so that a periodic check on values, with a view to timely replacement of lamps, can be kept.

It is frequently said that the sense of sight dominates the activities of the worker. Many instances of improved illumination leading to increased output

could be cited. For example, reports of the Industrial Health Research Board have revealed in one instance an increase of about 15 per cent. in output when the illumination was raised from 5 to 23 foot-candles.

Natural and Artificial Lighting.

Intensity of artificial lighting need not necessarily be as high as that of natural illumination, but we should at least try to imitate the good qualities of the latter, and to avoid glare, patchiness, and great contrast. The design of a building or the position of windows may, however, adversely affect the natural illumination of a room. In this connection Mr. Murray mentioned the case of a room in which the contrast between the great brightness of two narrow windows and the relatively dark wall surrounding them led to constant complaints—which were met by substituting frosted glass in the windows and adding a glazed partition in the side walls to admit some borrowed light. Another case was that of a top-lighted factory containing power presses. About 65 foot-candles of natural lighting were obtained in the gangways, but as little as 0.75 foot-candles on the actual dies. Moreover, operators had to look through relatively bright press guards in order to see their work. The illumination of the dies should have been at least equal to, and preferably higher than, that in the rest of the room—instead of being very much less.

After referring to the fact that "suitable and adequate lighting" is called for in regulations under the Factory Act relating to certain industries (building. shipbuilding, chemical vitreous enamelling, pottery, fruit preserving docks), the author commented on the relation between lighting and accidents.

Shadows.

Danger may result not only from insufficient lighting, but also from improperly placed lights. In one instance described the shadow of a pipe was cast along the length of the top step of a flight of stairs, so as to render it unobservable to a quick glance. This led to frequent falls, until the defect was remedied by the substitution of a diffusing fitting for the lamp and conical shade which had cast the harsh shadow. Flickering lights and shadows cast by moving objects may be very troublesome. But shadows are not always undesirable. In one factory general lighting of 8-9 foot-candles was considered by workers much inferior to the old system of individual lights for each drill. It was, in fact, found that with the general lighting the indentations made by centre punch marks were as evenly illuminated as the surface of the metal, so that the drillers had to feel for the indentations with their fingers! Directional lighting was necessary to show up the marks clearly.

Troublesome shadows are liable to be cast by guards, which may also act as a screen between the operator and his work. Some form of lighting on the side of the screen remote from the operator is desirable, and the light should be directed on the work in the direction of view of the worker.

Special precautions are necessary in arranging lighting for the inspection of polished surfaces (stainless steel, aluminium, glass, etc.), which are liable to reflect the light upwards into the observer's eyes. For large sheets a form of inverted trough fitted with a translucent screen below the lights, and affording a brightness of about 3-4 candles per square inch has been found to answer well.

Low Voltage Local Units.

The provision of small low voltage lamps with reflectors for illuminating the working areas of machines is steadily increasing. It is essential that lamps and reflectors should be small, since the light source must be mounted between the worker and his work. "Bus" lamps operating on 12 volts, provided from a transformer, serve the purpose. A high illumination can be economically secured, and the light can be adjusted to the desired position. If this is placed between the operator and the job reflected glare is eliminated. In addition, current consumption and maintenance costs are low and there is little risk of electrical shock, especially if one of the secondary terminals of the transformer is earthed.

If such low voltage local lighting is provided there should also be moderate general illumination, of the order of 2 to 10 foot-candles, in addition.

The lighting of textile processes affords another opportunity for special methods. Until recently in a few lace factories in the Midlands the use of candles was general.

The latest development is to install permanent lights with small trough reflectors within the machine, or alternatively portable low voltage handlamps to facilitate examinations and the repair of broken threads. A general system of artificial daylight has been found advantageous for the lighting of safety razor blades. In some such installations illumination of a very high order (150-200 foot-candles) has been found expedient. The inspection is carried on in small cubicles, each with its own light, and lined with black velveteen

Electrical Accidents.

In the concluding portion of his address Mr. Murray discussed electrical accidents and emphasised the desirability of ensuring that any metal at all liable to become "alive" should be earthed. Metal lampholders are common causes of accidents, as it is difficult to ensure that the insulation of the holder is maintained in a safe condition. Insulated lampholders should be substituted for metal ones whenever they are within the reach of persons who might accidentally make contact to earth. Screw cap lampholders without skirts may also prove a source of danger. There are five ways in which such a holder can be wired—only one of which is correct! In the case of portable lights precautions in regard to earthing are especially needful. Low voltage types are a great boon, especially for use inside boilers, where the worker may be perspiring freely.

In conclusion, Mr. Murray remarked that he had been asked to deal somewhat fully with electrical risks and safeguards against them, because the facts are not sufficiently realised by non-technical people and it was expedient to give them publicity. Other forms of lighting were not immune from accidents, but in the case of electricity risks were less evident, and the need for instruction correspondingly great.

The risks described were all due to imperfections of apparatus or arrangements. It was easy to provide safeguards—if users would be careful only to avail themselves of first-class material and fittings of a safe character.

Ten Years of Architectural Lighting

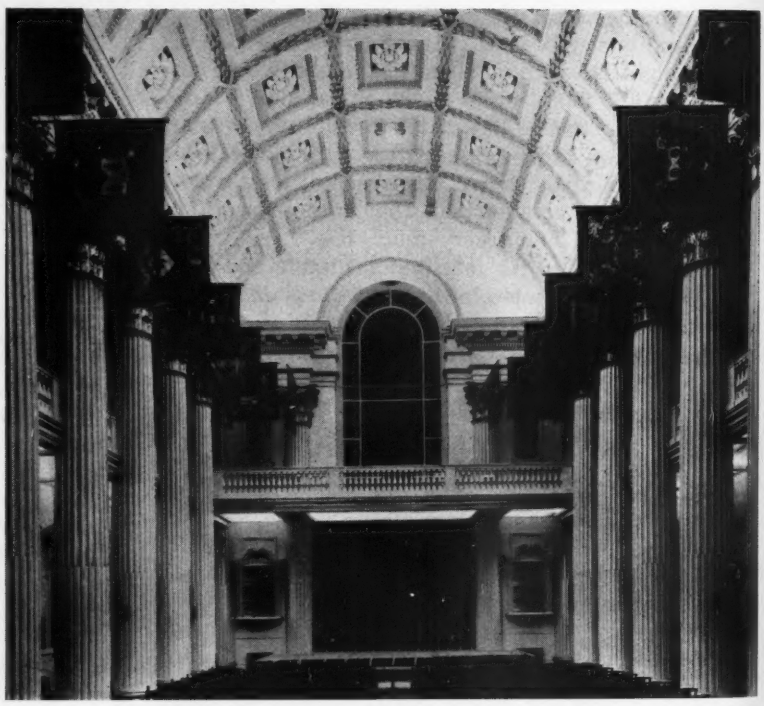
by R. O. SUTHERLAND, A.R.I.B.A.
(E.L.M.A. Lighting Service Bureau)

Approximately ten years ago, lighting first received the keen interest of architects. The present time might aptly be described as a milestone marking the path of progress which illumination and architectural design have trodden together since the realisation that they had a common bond. The purpose of their mutual object was to vest illumination as a part of community of interests rather than to consider it singularly as a needful amenity introduced into buildings solely for the purpose of lighting.

Illumination has always played a rôle in design for the reason that the mere presence of light in a room or on the face of the building excites interest This interest is in two directions, the one estimates the usefulness of the light and the other appraises the form of its source.

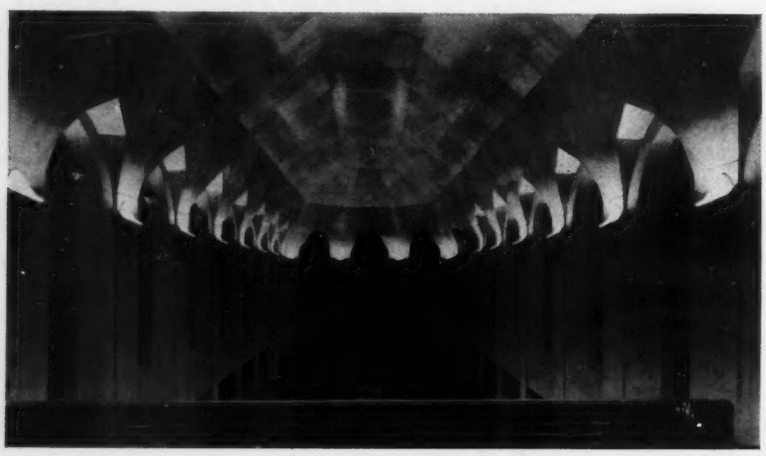
The history of architectural lighting as it is known to-day received a large measure of inspiration from the French Colonial Exhibition in 1925. As a result of the illumination shown at this festival, ornamental features in the form of tiles and richly decorated panels in moulded glass were popularised in building, particularly those used for catering and entertainment purposes.

The very floral character of this lighting soon gave way to a more restrained treatment as the modern note in architectural design developed. Plain sheet opal glazing was largely substituted for moulded glass, and this made it economical to have large areas of lighted panels, as well as to provide surrounds to openings in the form of illuminated architraves. Once the idea of converting an architectural element into a lighting feature was established, it rapidly became a typical method of architectural lighting technique. There



THE EGYPTIAN HALL (MANSION HOUSE), LONDON

One of the most convincing illustrations showing how interiors are improved by the technique of architectural lighting.



ST. ANDREW'S CHURCH, CHEAM.

This lighting design by the indirect method demonstrates the effects of directional light on grained surfaces. The ceiling is of plywood which appears in light and dark shades according to whether the rays run with or against graining.

THE LIBRARY, CAMBRIDGE UNIVERSITY.

The practice of lighting from the top of fitments is charmingly illustrated in this design. The illumination emphasises the architectural treatment in a dignified and simple manner.

followed illuminated lintols and beams, the latter finding considerable popularity.

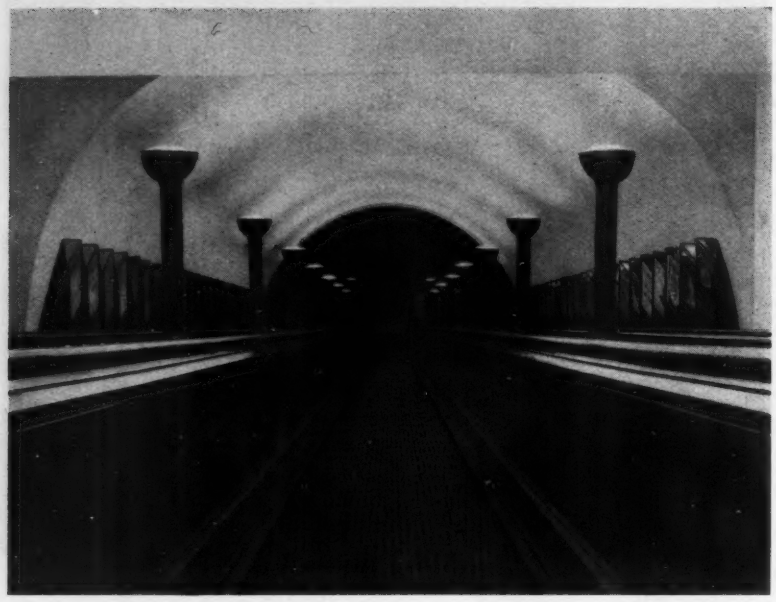
This increased use of lighting features attracted the public and before long, the attention was given to existing building with a view to adding similar lighting schemes. Popularity of the brilliantly lighted glass, often built into the building, soon gave rise to the application of lamps to existing cornices and laylights which were found to be suitable for the installation of lighting equipment; it was also found practicable to use the recesses of coffered ceilings in which to place lamps. In this way advantage was taken wherever possible of converting architectural features into factors or architectural lighting, a good example of this being the Savoy Theatre and the Mansion House.

Such schemes as the above called for the concealment of the lamp and its position. In laylights, the obscuring of the lamp image was usually obtained by the use of suitable glass and calculated positioning of the lamp. As regards cornices it was found desirable to place the lamps in such a manner that the lighting on the wall was reasonably even. Experience showed that other considerations had to be taken into account such as the proportion of frieze height to a room width, the provision of adequate space for lamps, and similar details concerning " cut off " and lines of vision. The inadequacy of space in many existing cornices and the low heights of modern ceilings popularised the use of strip-light lamps used in conjunction with a shaped reflector.

From existing features readily adaptable to architectural lighting it was but a short step to the introduction of the specially made up cove or channel types of sections. Unlike cornices which had to conform to established practice in design there were no hampering conventions as to the use of this new

BROADCASTING HOUSE, BIRMINGHAM.

The lighting treatment here is the chief centre of interest and characterises the design of this interior. This suspended trough is very architectural in conception, and as the photograph shows provides good illumination.



UNDERGROUND RAILWAYS (LONDON) ESCALATOR.

To Londoners and visitors to London this is a very familiar example of architectural lighting. The barrel ceiling is lighted from standards spaced at 8 foot intervals, each containing a 100-watt pearl lamp in a suitable reflector. The illumination, besides being ample for the needs of the traveller, is also sufficient for the vault sides to be used as advertisement space.

method of lighting. The cove (which can be seen to advantage at Derry and Toms, London) flowed flexibly in straight or curved lines, first about ceilings and later upon wall surfaces, producing bands of illumination in interior decoration schemes. At the same time there came into prominence a trough system of illumination consisting of a U-shaped lamp container which could be either suspended on the ceiling (as at Birmingham B.B.C.) or incorporated as a solid part of the building structure.

The desire for new lighting schemes led to many innovations, and from a number of progressive ideas there emerged two that have become recognised practice. One is that of using the tops of equipment in which to place lamps, usually in reflectors, flood-lighting the ceiling, in the manner used for the Cambridge library. The other was that of building a false ceiling from which powerful lights threw illumination on wide expanses of walling, the system adopted largely at Fischers Restaurant. This development of flooding with light large spaces of the building interiors, showed that the installation of fewer and more powerful lamps was inherently more efficient than the older practice of using a great number of smaller units. As a result of some interesting effects unexpectedly obtained from the texture of wall faces thought was directed towards the study of lighting on decorative surfaces.

In the absence of suitable equipment upon which to instal lighting elements resort was made to the employment of wall brackets and floor standards which are best designed to read with wall and floor treatments. The association of the lighting scheme with the general plan was established as one of the fundamental purposes of architectural lighting.

While architectural lighting had been maturing and becoming more rational each year the Electric Lamp Manufacturers' Association furthered progress by designing the linear light source which is now known as the "Architectural lamp." It found favour among architects and the public due to its comparatively low intrinsic brightness in combination with the advantage of providing numerous standard

SUDBURY TOWN UNDERGROUND STATION BOOKING HALL.

Two special pylons incorporate indirect reflectors in the tops and local direct lighting in the stems. The general indirect lighting is combined with just enough bright local lighting to dispel the feeling of dulness that indirect lighting produces alone. An illumination of about 5 foot-candles was obtained.

shapes and colours. These lamps contributed to flexibility in design and were easily applied to most sets of conditions.

The present time finds the architect with a wide selection of systems from which to choose his materials in lighting design. The choice is supplemented by improved electrical equipment in the form of reflectors and in scientific developments such as the coiled coil lamp and electric discharge light sources. Additional interest centres on the many possibilities of glass edged lighting similar to that of the R.I.B.A. building staircase, and illumination on decorative surfaces, both of which are now recognised to have considerable aesthetic character. Fittings are now used as elements of architectural design being installed in positions which set them off as essential features in the building equipment and decoration, a technique which was employed recently in the Bexhill Pavilion.

Great strides have been made in the exterior illumination of buildings to make the lighting necessities of a façade harmonise with the architectural form of the building, and this tendency finds confirmation in the new shop premises of Simpson's in Piccadilly, London, the illumination of which was illustrated in the last issue of *Light and Lighting* (November, 1936, p. 344).

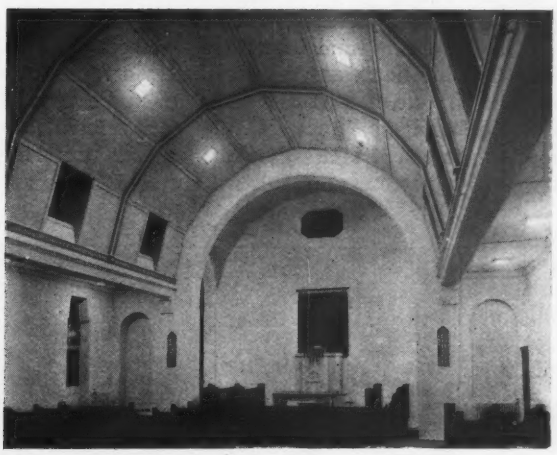
THE SHAKESPEARE MEMORIAL THEATRE GALLERY.

At the Shakespeare Theatre, Stratford-on-Avon, most of the lighting is furnished by concealed sources. The auditorium is lighted mainly from slots at intervals on the curved ceiling surface, in which are concealed architectural lighting strips with lamps at 6 in. centres. At the back of the auditorium, at gallery level, five acoustic panels also serve as light-reflectors.

Floodlighting with Sodium Lamps

Lyons' Strand Corner House is here seen floodlighted with 22 150-watt "Philora" sodium electric discharge lamps. Eleven of these units are mounted at first floor level, and seven at fourth floor level. The façade as a whole appears quite brightly and evenly lighted. In all 3,520 watts are consumed. It is estimated that a wattage five to six times as great would have been necessary had the same illumination been provided by means of incandescent (filament) lamps with amber screens.

Modern Church Lighting



The above picture, showing the appearance of the new Congregational Church, Meads-lane, Seven Kings, Ilford, illustrates the application of the modern "built-in" style of lighting. A system harmonising with the clean-cut modern design of the building was desired by the architect, who finally adopted Holophane built-in Hedralite fittings. In the nave eight large units of this type, equipped with 150-watt lamps, are installed, and eight smaller (100-watt) units of similar type have been introduced in the aisle.

Simmonds and Stokes, Ltd.—New Address

Simmonds and Stokes, Ltd., manufacturers of "Niphan" system cable couplings and plugs, have moved their head office to Victoria House, Southampton-row, W.C.1. Telephone: Holborn 8637.

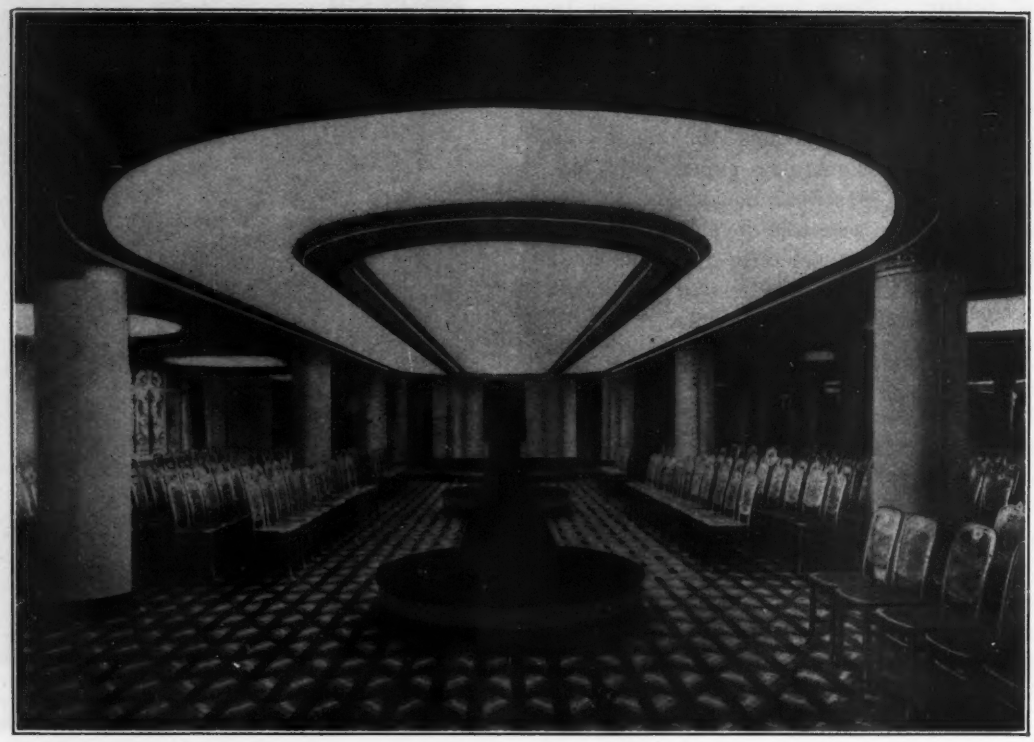


Fig. 1. The Mannequin Parade Room.

Architectural Lighting at Derry and Toms

We are indebted to Straight-Lite Reflectors, Ltd., for these two pictures, illustrating architectural lighting at Derry and Toms (High-street, Kensington). The method was considered very original when introduced, and it is still unusual to find such a big area lighted by indirect lighting of this form. One point that needs watching in such cases is uniformity of effect—spottiness of the illuminated surfaces is very unsightly. This was achieved by the use of Maxtrip " 2 " lamps in Super Straight-Lite Reflectors, giving an unbroken run of light with no trace of intervening shadows. We understand that the installation has proved to be a very successful one, which reflects credit on the architect (Mr. B. George, A.R.I.B.A.) and the chief engineer (Mr. A. G. Freeman). A feature of such installations is the softness of shadows, and it is of interest to note the use of this method in a room devoted to mannequin parades, where the appearance of the figure and the conditions of light and shade are highly important.

Fig. 2. The Ladies' Hairdressing Saloon.

Progress in Illumination

Some Further Notes on the Exhibits at the Opening Meeting of the Illuminating Engineering Society, on October 13, 1936.

(Continued from P. 356, November, 1936.)

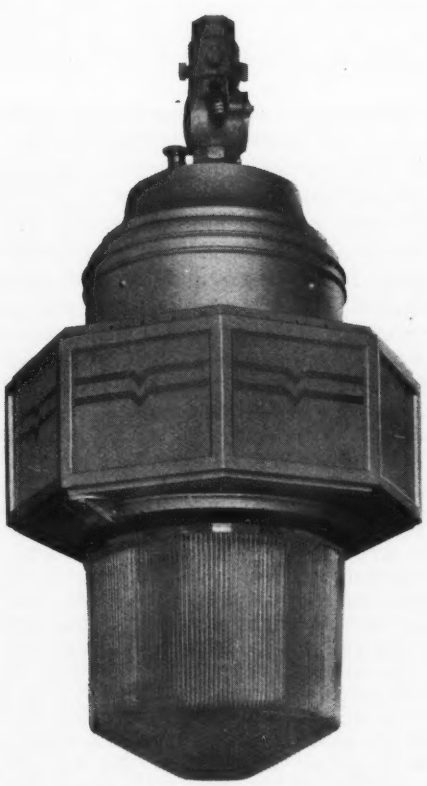
Di-Fractor Lanterns.

Amongst the numerous fittings shown on this occasion were several of the "Di-Fractor" type. The Oxford lantern shown by Mr. D. A. Hart (G.E.C.) aims at producing the desired distribution for street lighting by first changing the light from a tungsten filament (300 or 500 w.) lamp into a vertical strip of light, by means of a symmetric dome-shaped refractor and then re-distributing it by aid of the Di-Fractor bowl. Good distribution, coupled with suppression of glare, is thus obtained. The internal refracting prisms are aided by shallow vertical external flutes, which are stated to be practically self-cleaning. This lantern is well adapted to streets where an A.C. supply may shortly be substituted for the existing D.C. one, as only slight changes are necessary when mercury discharge lamps become available.

Another lantern, also shown by Mr. Hart, is likewise of the Di-Fractor type but decorative in style. The lantern is totally enclosed and dustproof. The central decorative panels may be either hexagonal or octagonal and the pattern may be modified. This fitting, too, can be readily adapted to the use of mercury discharge lamps.

Other forms of lanterns were shown by Mr. A. G. Brown (G.E.C.). These included a small edition of the Di-Fractor lantern having a non-axial asymmetric distribution and designed for a "staggered" arrangement in streets, and a new lantern with a large stepped opal glass bowl suitable for shopping parades and giving good all-round illumination.

The Oxford Di-Fractor Lantern.



A Decorative Di-Fractor Lantern.

A Fitting for Sodium Lamps.

Mr. G. J. Wells (Engineering and Lighting Equipment Co., Ltd.) shows a form of street lighting unit in which the light from a sodium tube is controlled by three mirrors on each side, one being set to a predetermined angle according to the nature of the road. The upward light is reflected through a diffusing glass screen running across the side of the fitting, and most of the illumination from this is superimposed at the mid-way point (i.e., about 75 ft. from the post). A ten degree cut-off is provided. Sufficient upward light is, however, diffused to prevent the somewhat depressing effect of a fitting with a complete "cut-off."

The Maxill Gas Lamp.

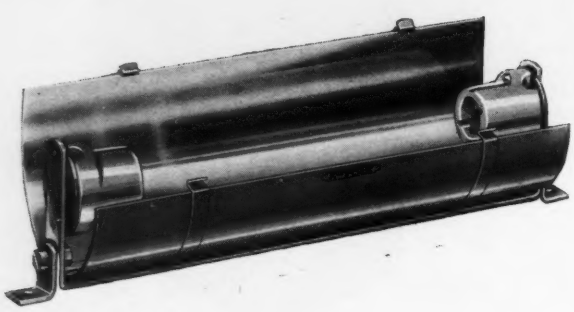
The Maxill Gas Street Lighting Unit, demonstrated by Mr. W. J. G. Davey (Messrs. W. Parkinson and Co.), consists essentially of twin burners at the foci of paraboloid faceted Staybrite Steel reflectors, which are positioned back to back. The reflectors are designed to secure evenness of illumination over the carriageway, rather than a high concentration of candle power in one direction. The patented burner is so constructed that the gas passes downwards through an annulus to the nipple, and thence upwards into the mixing chamber, drawing in air from the body of the lamp. This ensures efficient

combustion and also obviates the necessity for an elaborate ventilating device to prevent the possibility of contamination of the primary air by products of combustion. By aid of a bottom door, regulation of the gas and air, replacement of mantles and cleaning, can all be effected from the base, very important maintenance considerations.

Mr. Davey presents slides and diagrams illustrating experimental installations of such lamps and also his Circular Horizontal Illumination Chart, an extension of the original rectangular chart.

New Trough Reflectors.

Mr. W. E. Bush (The Curtis Lighting Company of Great Britain, Ltd.) showed a novel form of "X-Ray" trough reflectors which are suitable for the concealed lighting of cornices, laylights, alcoves, windows, showcases, pictures, murals, churches, auditoriums, theatres, etc. These units consist essentially of a metal frame to which is fitted a silvered glass "X-Ray" reflector of accurate contour to give a definite light distribution. The frame is standard



for three types of mirror, which can be changed from one to another in a few moments. The fixing brackets are adjustable so that the light may be directed in any desired direction. The ends of the units are left open, as the light escaping in this way avoids any effect of patchiness.

The units are suitable for two lamps from 25 to 60 watts, and are fitted with two back-entry porcelain B.C. lampholders. The standard exterior finish is silvertone, but other finishes are supplied to order. The type illustrated is the asymmetric unit giving even illumination over a wide area.

The dispersive type is designed for indirect lighting above false ceilings, behind windows, and various forms of alcove illumination. For cornices close to the ceiling, the concentrating unit produces a relatively narrow beam. This type is also useful when a long throw is required, as in church and picture gallery lighting.

Portable Photoelectric Daylight-Factor Meter.

The structural efficiency of a building in admitting adequate daylight to a given point is expressed by the "daylight-factor," i.e., the ratio (usually given as a percentage) of the illumination at the internal point to the simultaneous illumination at a point outside exposed to a complete hemisphere of sky.

The portable photoelectric meter shown by Mr. F. J. C. Brookes (National Physical Laboratory) is designed to measure daylight-factors of from 0.03 to 2.50 per cent.

Two rectifier photoelectric cells are used: one placed on the window-sill to receive light from a definite fraction of the whole sky-vault; the other, at the point in the room where the daylight-factor is required. A Morse key facilitates rapid change-over of a microammeter from one cell to the other. Depression of the key connects the microammeter directly to the terminals of the "inside" cell. Release of the key connects the microammeter to the "outside" cell, in parallel with a variable resistance acting as a shunt to the microammeter. This resistance is adjusted until depression or release of the key produces no change in the microammeter reading; the value of the resistance at balance gives the daylight-factor directly on the curve provided

Corrections for non-linearity in current-illumination relationships and for errors arising from the difference in colour of the light to be measured by both cells are incorporated in the final curve relating shunting resistance and daylight-factor. The inside cell is compensated for loss of sensitivity with increasing obliquity of the incident light.

In operation it is necessary only to connect the cells in circuit, the remaining instruments being permanently wired and mounted in a portable case which has compartments to hold the photoelectric cells and their holders and the necessary flexible leads.

Measurement of the Light-Centre Length of Electric Lamps having Filaments enclosed in Diffusing Glass Bulbs.

This apparatus was also shown by Mr. F. J. C. Brookes. If a small bright spot of light is projected on to one side of the bulb of a pearl or opal bulb electric lamp a shadow of the filament will be sharply defined on the opposite side of the bulb. This forms the basis of a method of determining the distance of the geometrical centre of the filament to the contact plate of the lamp cap—a distance known as the light-centre length of the lamp.

In the apparatus which was demonstrated, a lens is employed to form a small image of a concentrated filament gas-filled lamp on the bulb of the lamp under examination.

The position of the shadow of the filament on the opposite side of the bulb is made to coincide with a cross-wire, which is fixed on the axis of the system.

The vertical pillar holding the lamp under test is adjustable in height, and is provided with an engraved scale to indicate the light-centre length.

The "Photronic" Photoelectric Cell with Visual Correction Filter.

Mr. W. R. Ross (Weston Electrical Instrument Co., Ltd.) showed this dry disc type of photoelectric cell has distinctly established itself in the commercial field, which is designed for use with ultra-sensitive moving-coil instruments, such as those applied with photometers. The spectral response of the Weston "photronic" photoelectric cell spans the eye visibility range extending on either side into the ultra-violet and infra-red regions. The new "Viscor" correction filter has been developed to correct the deviation in spectral sensitivity of the cell so that it will now very closely approximate to the spectral response of the average human eye.

Mr. Ross stated that the cell, with this new correction filter in use, will, in general, be able to measure with an accuracy approaching ± 2 per cent. for light from tungsten sources, ± 3.5 per cent. for light from all continuous sources, and ± 5 per cent. for all commercial monochromatic sources. This combination of filter and cell has the important advantage of being able to measure more quickly the light emitted by various sources than is possible with the ordinary visual type of instrument. Chemical stability is ensured by the glass construction of the filter, and heating due to infra-red radiation will be retarded, as only a portion of the heat will reach the disc by conduction.

Purley Way, Croydon.

● **Years of patient research by Philips Laboratories has evolved a new method of street lighting—SODIUM.**

Exhaustive tests have proved that the golden light of "Philora" Sodium Lamps affords extraordinary VISIBILITY, to a degree hitherto quite unknown in public lighting.

In addition to this, "Philora" Sodium Lamps give as much as five times more light than ordinary lamps of similar size, and have a guaranteed life of 2,500 hours.

To these factors is due the success of "Philora" Sodium Lighting and its adoption by public lighting authorities all over the country, all of whom desire not only VISIBILITY but the most economical means of obtaining it.

PHILIPS "PHILORA" SODIUM LIGHTING

PHILIPS LAMPS LIMITED, ("PHILORA" DEPT.), 145, CHARING CROSS ROAD, LONDON, W.C.2.

A Colour Comparator

This comparator, shown by Mr. C. A. Morton (G.E.C. Research Laboratories, Wembley), is designed to permit the rapid testing of all parts of a coloured glass globe or other filter for compliance with a colour specification which can be defined by limit colour filters. No photometric bench is required and the apparatus is self-contained so that works' production or apparatus on site can be tested conveniently.

The glass under test is placed over an opal lamp and the comparison is made with other opal lamps combined with the limit colour filters in the comparator.

The field of view seen in the comparator consists of three parts of equal size as shown in Fig. 1.

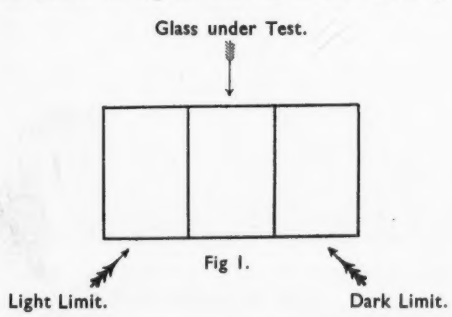


Fig 1.

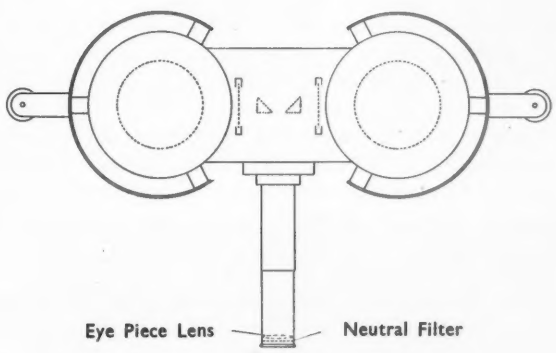


Fig. 2.

The test determines whether or not the colour of the glass under test lies between the two limiting colours as seen in the fields on either side of it.

The comparator consists, as shown in the plan view of Fig. 2, of two containers for the opal lamps, grooves for the limit filters, a prism to reflect each of the opal lamps into the field of view and a telescope through which the field is seen. A lens in the eye piece focusses the edge of the prisms and a neutral filter is inserted to reduce the field brightness to a

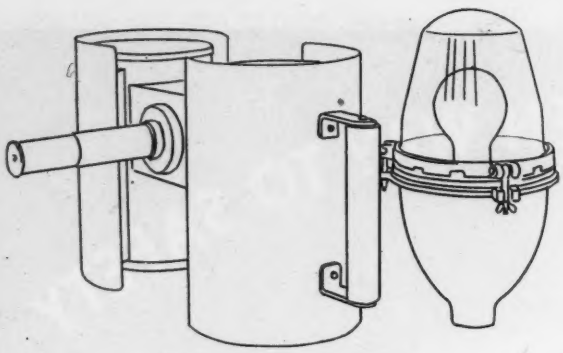


Fig. 3. Colour Comparator.
(Mr. C. A. Morton).

convenient value. With 100-watt opal lamps a 1-100th transmission filter is suitable.

In use, the lamp in the glassware under test is viewed from any direction in which the examination is required. The arrangement is illustrated in Fig. 3.

An Apparatus for the Rapid Plotting of Polar Curves.

A type of apparatus using a rotating photocell and plotting the galvanometer deflection directly on a vertical sheet of polar curve paper was exhibited by Mr. G. H. Wilson (G.E.C. Research Laboratories, Wembley). The rough rig shown at the meeting was a device for operating the rotating polar curve paper in a horizontal plan so as to facilitate plotting. The galvanometer is connected in the usual way to the photocell which can either rotate round the fitting under test or be used with a rotating mirror photometer. The new arrangement consists in the use of a mirror arranged with its plane at 45° to the horizontal to deflect the reflected beam from the galvanometer on to the horizontal polar curve paper. The turntable carrying the paper was rotated by hand so that the deflection of the spot lay successively along the angles to which the photometer was set. By these means the advantage of working upon a horizontal surface is added to the rapidity gained by plotting directly upon the polar pape rwithout the necessity for recording each reading separately.

[We regret to learn that, owing to indisposition, Professor G. B. Van der Werfhorst has not yet been able to furnish the description of the experimental form of visibility meter shown by him at the opening meeting.]

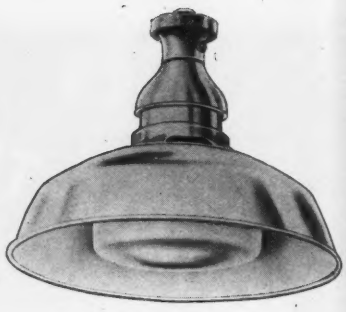
The following three fittings were shown respectively by Mr. Studholme, Mr. Lavery, and Mr. Imrie Smith, of Benjamin Electric, Ltd.

Electric Discharge Glassteel Diffusers.

As part of the expected extension of the range of reflectors for use with electric discharge lamps, a special design of the industrial diffusing unit has been made available in two sizes (150 and 250-watt types).

A feature is the white opal diffusing bowl, which softens the comparative harsh rays of the electric discharge lamp, giving a much more pleasing appearance, while the "Crysteel" enamelled reflector directs the light into a useful zone.

This fitting was switched on to enable the audience to judge the effect.



A Glassteel Diffuser Fitting for use with Electric Discharge Lamps.

Wide-Distribution Biflectors.

The specular control of light is usually associated with silvered glass or polished metal reflectors. It is, therefore, a matter of some interest to note that a vitreous enamel reflector is now available which, by full use of the specular component of reflection, produces a curve which comes in the British Standard Wide Distribution class.

To achieve this result with a reflector of practical dimensions, two circular reflectors are used, one above the other, the lower one taking over control of the light where the upper one terminates. This enables a cut-off of light to be obtained at 70° from the vertical, thus lining up with the B.S.I. and Home Office recommendations for R.L.M. or dispersive type reflectors. The spacing v. height ratio is in the order of $2\frac{1}{2}:1$, as against $1\frac{1}{2}:1$ for R.L.M., thus enabling this type of fitting to be mounted on quite low ceilings. It is available in both "Saaflux" and "X" type.

A wide Distribution Biflector.

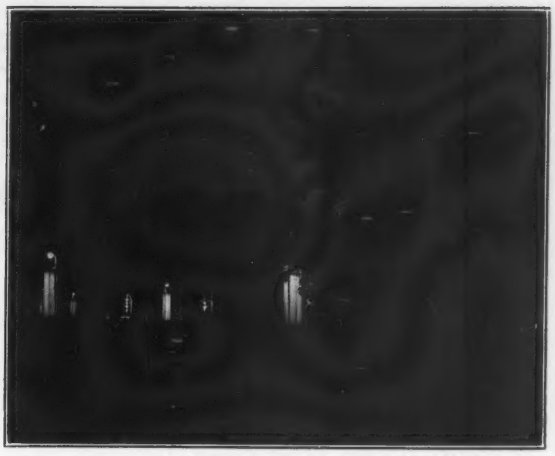
Ile Fittings.

In view of the demand for vitreous enamelled reflectors for the illumination of petrol pump islands and similar locations, a type has been produced which can be mounted direct on to the top of a pole, without the usual swan-neck bracket. This results in a considerably more pleasing design, which is of importance, due to the movement in favour of more attractive petrol service stations.

The distribution of light approximates to that obtained from the R.L.M., the contour of the reflector being very similar with a cut-off of 70°. There is supplied with the fitting an adjustable screen by which the cut-off can be reduced to 60° from the vertical. This is very useful in preventing glare when the fitting is mounted close to the petrol pumps, etc., as is often done. The mounting bracket is arranged to fit over a 2-in. outside diameter pole and is secured by the two set bolts.

(To be continued).

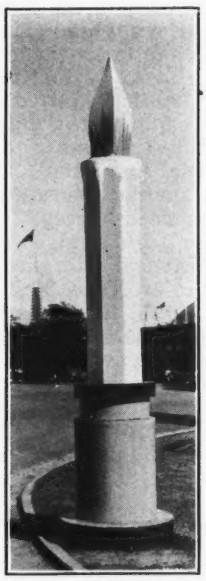
The Grand Plaza. About 25,000 people assembled in front of the Band Shell during the closing ceremonies. The Union Jack has just been lowered. In the distance the lights outlining the shore of Toronto Island are seen.



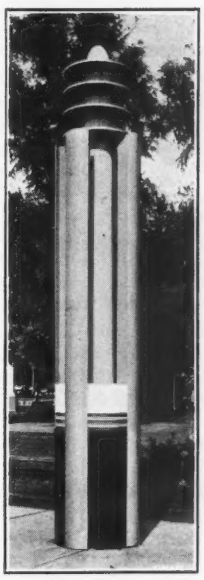
Another view of the Grand Plaza, showing neon pylons and the Band Shell with Lake Ontario in the distance.

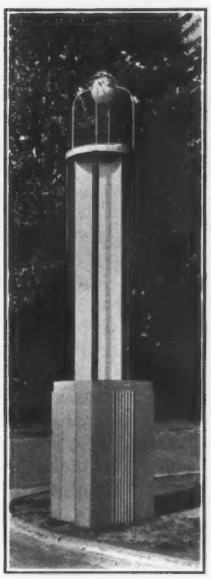
Exhibition Lighting in Canada

Through the courtesy of Mr. F. C. Mayberry, who is associated with the Department of Works of the Canadian National Exhibition we are able to present these pleasing views showing the original spectacular lighting of this exhibition, which was held in Toronto this year. These interesting devices carry on the ideas originated at the recent exhibitions in Paris (1931) and Brussels (1935) and embody mainly indirect lighting methods, which are seen to great advantage in the charming natural surroundings.



Two special fixtures used for street decoration during the period of the celebrations.





Two types of pylons utilising red and green neon tubes for indirect lighting effects.

Here some of the original giant candle devices, illustrated above, are seen in use.

The Jubilee Boulevard and Automotive Building, showing white opal glass pylons in one of the four small illuminated fountains.

Accurate Lantern Photometry Without the Use of Standards

By R. MAXTED, B.E.Electrical, B.E.Mechanical.

Introduction.

The method here described was developed in an attempt to improve upon the accuracy and avoid the inconvenience of more orthodox methods of calibrating lantern photometers during tests upon lanterns using electric discharge lamps.

Experience has shown the scheme to be applicable with equal success to all forms of electric lamps, and checks have been made against standards in the B.T.-H. Research Laboratory. In addition to having the advantages originally sought, the method appears to offer considerable assistance to those who wish to make accurate lantern tests with quite inexpensive equipment.

Thus the use of photoelectric cells has greatly simplified and cheapened the construction of lantern photometers, and this method of calibration avoids the cost of establishing and maintaining standards for the various light sources now in everyday use.

A recent paper* dealt with the advantages offered by the photoelectric cell in lantern photometry. It is not intended to deal in this article with the relative merits of the various types of photometers incorporating photoelectric cells, but to describe a method of operation which is applicable to all. It is, however, assumed that the photometer cell will be operated with a linear response, and that the distance between light source and cell is sufficient for the inverse square law to hold.

At this stage the author would like to lay stress upon the extreme simplicity of the procedure as finally described for use in practice, as this is some justification for the ominous list of symbols which now follows, and for their free use in the presentation of the case:

C=Cell calibration in foot-candles per micro-ampere.

L_t =Total luminous output of test lamp when first calibrated.

L_a =Actual total luminous output of lamp during lantern test.

L_s =Total luminous output of source, for which lantern C.P. figures are required.

$M.S.C.P_t$ =M.S.C.P. of test lamp corresponding to L_t.

$M.S.C.P_a$ =M.S.C.P. of test lamp corresponding to L_a.

$M.H.C.P_t$ =M.H.C.P. of test lamp corresponding to L_t.

$M.H.C.P_a$ =M.H.C.P. of test lamp corresponding to L_a.

I_x =Candle-power in any direction X from lantern (corrected to required total output of source).

I_θ =Candle-power of bare test lamp at an angle θ to the downward vertical.

R_{ht} = Average cell reading at horizontal of lamp, corresponding to L_t.

R_{ha} =Average cell reading at horizontal of test lamp corresponding to L_a.

R_{st} = Mean cell reading corresponding to $M.S.C.P_t$.

R_{sa} = Mean cell reading corresponding to $M.S.C.P_a$.

R_x =Cell reading in any direction X from lantern.

ϕ = Angle of azimuth.

θ = Angle to the downward vertical.

D=Distance between cell and lantern.

* Recent Improvements in Integrating and Polar Curve Photometers of the Photoelectric Pattern. By Lt.-Col. Kenelm Edgcumbe, April 28, 1936.

General Principles and Conventional Methods of Calibration.

In the photometry of street-lighting equipment modern requirements call for the accurate determination of the light flux distribution in vertical planes in many azimuthal directions. Thus the familiar Iso candle diagram, which is useful in the direct comparison of lantern distribution, is plotted from these measurements. So is the Iso foot-candle diagram, which is valuable in depicting the intensity, azimuthal direction, and angle of incidence of light striking all points of the road surface, and in correlating these with the brightness diagrams showing the resultant reflection of light from the surface to the eye, for various conditions of road surface.

For this purpose, lantern candle-power figures are required for both initial conditions and average operating conditions of the lamp and lantern.

In the laboratory where this method has been developed, lantern tests are made with a perfectly clean lantern and a lamp having a total luminous output approximating to the required average over-life.

The initial candle-power figures are obtained by increasing the test figures in the ratio of initial lamp lumens to actual test lamp lumens.

Figures for average operating conditions are based upon the recognised average luminous output of the lamp throughout life, and, in addition, an allowance is made for practical tolerances in lantern condition and accuracy of erection. Test figures are, therefore, corrected to a total luminous output from the lamp which is actually below the average over life.

Lantern candle-power figures are, therefore, required for a lamp output of L_s lumens, and this figure naturally differs from the actual total output from the test lamp, L_a lumens.

Thus, the candle-power I_x in a certain direction from the lantern is determined as follows:—

$$I_x = R_x \times C \times D^2 \times \frac{L_s}{L_a} \quad \text{..... (I.)}$$

In evaluating I_x from this formula, the orthodox procedure is to determine the cell calibration C, either by means of a photometer bench and standardised lamps or preferably, as stated in the paper referred to above, by placing a standardised lamp in the lantern photometer itself.

This is a simple matter in the case of incandescent filament standards, which can be relied upon to maintain their characteristics within the accuracy required. With other modern sources, the use and maintenance of standards requires much more elaborate equipment and the services of specially trained and calibrated workers. Furthermore, it is necessary to determine L_a, the total luminous output of the test lamp, at the time of the lantern test.

Apart from the cost and inconvenience of these separate calibrations of test lamp and cell, it is probable that, with some types of sources, a total error of say $\pm$ 6 per cent. may occur unless precision photometry is a routine part of the laboratory work.

The New System of Lantern Photometer Calibration.

The system of calibration to be described may be outlined briefly as follows:—

The total luminous output, L_a, of the test lamp is determined on the lantern photometer at the time of the lantern test. L_a is then expressed in terms of the cell calibration, C, and when this value is sub-

stituted for L_a in formula I., it will be seen that both L_a and C vanish.

Thus the candle-power of the lantern in any direction can be very accurately determined on any required lumens basis, L_s, without evaluating at all the actual calibrations of the test lamp or of the photo-electric cell.

Furthermore, the method does not depend upon the consistent performances of the test lamp and cell for periods greater than the few hours required for a lantern test. The combined calibration of the test lamp and cell involves the determination with the photometer of the MSCP of the lamp (in terms of C), at the time of test, and by the simplified process described later this is a matter of minutes.

Determination of L_a in Terms of C.

The total luminous output, L_a, of the test lamp may be determined in terms of the cell calibration, C, as follows:—

$$L_a = \int_0^{2\pi} \int_0^{\pi} I_\theta \sin\theta \, d\theta \, d\phi$$

and since $I_\theta = R_\theta \times C \times D^2$, L_a is obtained in terms of cell readings and C.

Again $L_a = 4\pi \times MSCP_a$, and in making the above integration in practice, it is convenient to determine $MSCP_a$ in terms of C, by taking readings on the photometer in a number of planes through the axis of the source.

Thus in the case of the Mercra lamp, the lamp is operated vertically, and it is found that accurate results are obtained if cell readings are taken at 20 Russell angles in each of 36 vertical planes spaced at 10° in azimuth. These readings are meaned, giving an average reading, R_{sa}

Then $MSCP_a = R_{sa} \times C \times D^2$

and $L_a = 4\pi \times R_{sa} \times C \times D^2$..... (II.)

Fundamental Formula of the Method.

If the expression for L_a shown in Equation II. is substituted in Equation I., C and L_a are eliminated. Thus:—

$$I_x = R_x \times C \times D^2 \times \frac{L_s}{L_a}$$

$$= \frac{R_x \times C \times D^2 \times L_s}{4\pi \times R_{sa} \times C \times D^2}$$

i.e., $$I_x = \frac{R_x}{R_{sa}} \times \frac{L_s}{4\pi}$$ ..... (III.)

Hence the candle-power in any direction from the lantern is determined by cell readings (in micro-amperes) and the chosen value of L_s.

Simplified Procedure.

It is at once obvious that, whilst Equation III. provides a solution to the main problem of rendering the photometer independent of outside calibrations, the method is somewhat cumbersome. Thus, the calibration would involve the taking of some 720 readings to determine R_{sa}, and this would occupy at least two hours.

A modified method has been developed which requires the determination of only the MHCP of the lamp and involves the taking of only thirty-six readings. This modification was based upon the assumption that the relationship between MHCP and MSCP would remain constant for a reasonable life of any suitable test lamp.

Then

$$\frac{R_{sa}}{R_{ha}} = \frac{R_{st}}{R_{ht}}$$

and $$R_{sa} = \frac{R_{st} \times R_{ha}}{R_{ht}}$$

Substituting this expression for R_{sa} in Equation III.:

$$I_x = \frac{R_x \times R_{ht}}{R_{ha} \times R_{st}} \times \frac{L_s}{4\pi}$$

$$= \frac{R_x}{R_{ha}} \times \left(\frac{R_{ht}}{4\pi \times R_{st}}\right) \times L_s$$

$$= \frac{R_x}{R_{ha}} \times \left(\frac{R_{ht} \times C \times D^2}{4\pi \times R_{st} \times C \times D^2}\right) \times L_s$$

i.e., $$I_x = \frac{R_x}{R_{ha}} \times \frac{MHCP_t}{L_t} \times L_s$$ ..... (IV.)

The term $\frac{MHCP_t}{L_t}$ is a constant for the lamp and is evaluated entirely from readings taken on the photometer when the lamp is first adopted for lantern tests. (It should be noted that $\frac{MHCP_t}{L_t}$ is entirely independent of C.)

Thereafter, the combination of lamp and cell is recalibrated at each lantern test, merely by determining R_{ha} from the mean of thirty-six readings taken at the horizontal of the bare lamp.

This modification to the original method has been found entirely satisfactory in practice.

A Brief Account of the Method in Practice.

It may be helpful to describe briefly the complete practical procedure in the case of tests on lanterns using Mercra lamps.

A lamp is reserved for lantern tests only, and this is aged for at least 300 hours. The lamp, which must have evenly clear glass walls, is placed vertically in the lantern photometer and cell readings are taken in thirty-six vertical planes spaced at 10° in azimuth. In each plane readings are taken at the following angles to the downward vertical:—

18.2, 31.8, 41.4, 49.5, 56.6, 63.3, 69.5, 75.5, 81.4, 87.1, 92.9, 98.6, 104.5, 110.5, 116.7, 123.4, 130.5, 138.6, 148.2, 161.8.

These 720 readings are averaged to give R_{st}. In addition, readings are taken at 90 degrees to the downward vertical in each plane, and these thirty-six readings are averaged to give R_{ht}.

From R_{st} and R_{ht} as thus obtained, the term $\frac{MHCP_t}{L_t}$ is evaluated.

Thus $$\frac{MHCP_t}{L_t} = \frac{R_{ht}}{4\pi R_{st}}$$

This is a constant for the lamp, and may be checked at convenient intervals. If a variation were found, it would be advisable to discard the lamp.

In subsequent lantern tests the bare lamp should be set up on the photometer head, and thirty-six cell readings taken at 90° to the downward vertical to determine R_{ha}. This operation should take place either immediately before or immediately after the lantern test, and if the test has been unduly long it may be made both before and after to check that no appreciable variation in cell response has occurred. In the case of discharge lamps care should, of course, always be taken to allow the lamp to run up fully.

In determining I_x, the value of R_{ha} thus obtained is used in the formula of equation IV.

Typical Values of the Factor $\frac{MHCP_t}{L_t}$

The following values for $\frac{MHCP_t}{L_t}$ were obtained with Mercra lamps of various types:

Lamp No.	Watts.	$\frac{MHCP_t}{L_t}$
400/1 ...	400 ...	0.923
400/2 ...	400 ...	0.928
250/1 ...	250 ...	0.987
250/3 ...	250 ...	0.986
150/1 ...	150 ...	0.927

These results are seen to be in very close agreement for lamps of the same type. It should not be assumed, however, that the values quoted will apply to any lamp of the same type, as lamps of different makes may vary in mechanical details, and even lamps of the same make chosen at random will vary in certain dimensions within the agreed limits. The pairs of lamps referred to above were of identical construction and dimensions.

In this connection it is interesting to note the variation of the factor with the differing proportions of the various sizes of lamps.

Constancy of the Factor $\frac{MHCP_t}{L_t}$

Data is still being collected upon this point. From that already available it appears that for any one lamp there is no variation beyond that due to experimental error. For the present, it is expected that check values of $\frac{MHCP_t}{L_t}$ will be within $\pm$ 1 per cent. An appreciable increase of, say 2 per cent. would indicate that light absorption is increasing at the ends of the lamp, and the lamp should be discarded.

Application of Method to Horizontal Lamps.

The method as described above applies especially to lamps of the Mercra type, operating with the axis vertical. Only a minor variation is required in calibrating a lamp operating with the axis horizontal as in the case of most Sodra lamps.

The lamp is set up with the axis lying in the plane containing the path of the cell, and readings at Russell angles are taken in this plane, one end of the lamp being taken as 0° and the other as 180°. The lamp is rotated on its axis, 10° at a time, to give the various "azimuthal" directions.

Apart from this modification the method is identical for both types of lamp.

Conclusions.

In conclusion, it should be stated that this method is being used with Mercra, Sodra, and filament lamps, and it has been found a considerable aid even in a laboratory which is fully equipped with standards, and which is continuously doing precision photometry with the normally accepted methods. Some of the advantages have already been referred to, and others are obvious. They may be summarised in the statement that *calibration becomes an integral part of each lantern test.* The following points may be selected:

(1) The problem is avoided of maintaining numerous standards for the many sources of varying colour. Even in a well equipped laboratory, this is a valuable characteristic of the method when lantern tests are required with experimental sources, having for example, varying contents of red light.

(2) The cell is calibrated with the lamp actually used for tests, thus avoiding errors due to differences in energy distribution between the test lamp and a standard lamp.

(3) The cell is calibrated under the precise conditions of test.

(4) Calibration of both lamp and cell is made with the wattmeter and microammeter actually used for tests, thus eliminating any errors in meter calibrations.

(5) The constancy of lamp and cell performance is not relied upon for more than a period of a few hours.

(6) A tolerance of possibly $\pm$ 6 per cent. is avoided by the elimination of separate lamp and cell calibrations of the orthodox method.

The author wishes to thank the directors of the British Thomson-Houston Co. and Mr. Warren, chief of the Research Laboratory, for permission to publish this data, and also to express his gratitude to Mr. Ruff, Mr. Bertram, and other members of the laboratory who have collaborated both in the development work and in the preparation of the paper.

Literature on Lighting

(Abstracts of Recent Articles on Illumination and Photometry in the Technical Press)

(Continued from Page 351, November, 1936)

II.—PHOTOMETRY

249. Photocell Correction Filter.

J. Sci. Inst., 338, Oct., 1936.

A visual correction filter has been developed which it is claimed, when used with a certain photo-electric cell, produces a cell sensitivity almost identical with that of the human eye. It consists of yellow and blue-green glasses cemented together. It is claimed that for commercial monochromatic light sources it is corrected to about $\pm$ 5 per cent., but it is pointed out that this accuracy only holds for normally incident light. For various reasons the light output falls off more rapidly than the cosine law requires. S. E.

250. Photoelectric Cells.

R. C. Walker. G.E.C. Journal, VII., No. 4, pp. 249-261, Nov., 1936.

The characteristics of vacuum and gas-filled cells are discussed, together with their applications in photometry and other requirements. C. A. M.

III.—SOURCES OF LIGHT.

251. New Developments in Mercury-Vapour Lamps.

A. B. McKenna. El. Journal, Vol. 33, No. 10, p. 439, Oct., 1936.

A review of recent progress in the design of high-pressure mercury-vapour lamps. The new quartz lamps and lamps employing fluorescent outer jackets are described. R. G. H.

252. The Optical Properties of Electric Light Tubes With Fluorescent Walls With and Without an Opal Glass Layer.

H. Fischer. Zeits f. Techn. Physik, 10, pp. 337-340.

The author claims that an opal layer on a fluorescent glass of a lamp will in many cases render the lamp more efficient by preventing total internal reflection. Theoretical considerations and test results are given. W. R. S.

253. Bi-post Lamp Construction.

Anon. El. Journal, Vol. 33, No. 10, p. 449, Oct., 1936.

A short description of a 1,000 watt tungsten filament lamp employing a special filament construction and Pyrex glass. The lamp is said to be only half as large as the normal 1,000 watt lamp. R. G. H.

254. Krypton-Filled Lamps.

Anon. Elect., 117, p. 514, Oct. 30, 1936.

The advantages of krypton over the nitrogen-argon mixture as a filling for gasfilled lamps are discussed. Energy losses are reduced, and energy transformed into visible radiation is increased. A krypton-filled lamp

giving 1,500 lumens requires only 91 watts, as against 100 watts in the case of the nitrogen-argon lamp. The krypton lamp costs more, but an economic case can be made for it. C. A. M.

IV.—LIGHTING EQUIPMENT.

255. Fog Penetrating Railway Signal Lamps.

A. E. Tattersall. J. Sci. Inst., 313, Oct., 1936.

Two forms of powerful light signals are described. One form employs a half silvered lamp and a mangin mirror, to produce a parallel beam, which is passed through a clear sheet of coloured glass. Using an 8 v. 5 w. lamp with a compact filament, a beam of 41.00 c.p. has been obtained. In the second form of lamp a much deeper reflector is used, collecting a greater proportion of the flux emitted by the lamp. With an 8 v. 10 w. lamp a beam of 35.000 c.p. with a spread of 4 degrees is produced. To avoid trouble due to lamp failure, the greatest tendency is towards the use of double filament lamps. S. E.

256. Large Iris Shutter for Searchlight.

Anon. El. Times, 90, p. 559, Oct. 22, 1936.

An 80-in. diameter iris shutter has been made for use with a searchlight for signalling purposes. It can be hand or motor driven. A photograph is given. W. R. S.

257. Polarised Control for Street Lights.

A. S. Brookes. El. World, 106, p. 3175, Oct. 10, 1936.

A description is given of a street-lighting installation in which the switching is performed by a d.c. impulse operating polarised relays. The applied voltage for the impulse is between a pilot wire and earth, and the operating current is about 60 milliamperes. S. S. B.

V.—APPLICATIONS OF LIGHT.

258. Lighting Design.

Anon. Light, V., No. 8, pp. 41-44, Oct., 1936.

Supplementary lighting for industrial and special requirements is grouped into three classes according to the difficulty of the visual tasks involved. Class A calls for upwards of 100 foot-candles, Class B ranges between 50-100 foot-candles, and Class C ranges between 30-50 foot-candles. Typical examples of the use of all types of such equipment for both industrial and other purposes are shown. Particular attention is given to industrial processes involving detailed inspection of finished products. C. A. M.

259. Electrical Manufactures Exemplify Adequate Light Production.

Anon. El. World, 106, p. 3328, Oct. 24, 1936.

Some photographs and details are given of the lighting schemes adopted by the Westinghouse Company in certain departments. Intensities of illumination of 18-22 foot-candles are claimed. S. S. B.

260. 60 Foot-candles Stimulate Factory Output.

Anon. El. World, 106, p. 3314, Oct. 24, 1936.

Full details are given of the lighting of an American factory, with a large plant for die making and punching operations. Most of the units combine filament lamps and Cooper-Hewitt mercury-vapour lamps, and are arranged to combine varying proportions of the two colours of light for different operations, though two types of fitting only are used. Most of the lighting is provided by general lighting units, local lighting being rarely necessary. S. S. B.

261. Some Technical Aspects of Architectural Lighting.

R. O. Ackerley and E. H. Penwarden. G.E.C. Journal VII., No. 4, pp. 304-312, Nov., 1936.

Detailed consideration is given to problems arising in the design of cornice lighting equipment. Considerable attention has also been given to the design of laylights. C. A. M.

262. Combination Units Better than Daylight.

Anon. El. World, 106, p. 3325, Oct. 24, 1936.

Details of the lighting of a large drafting room are given. The main interest lies in the use of separate filament lamps and mercury-vapour lamp units, which in the result have combined to give an excellent installation. S. S. B.

263. Luminous Advertising.

G. R. La Wall. Light, V., No. 8, pp. 24-25, Oct., 1936.

Detailed diagrams with photographs are given of a luminous facia sign and shop window lighting of a hardware store. C. A. M.

264. Lyons Corner House Brasserie.

Anon. El. Times, 90, p. 506, Oct. 13, 1936.

Gives photographs and a short account of the lighting of a restaurant. A large "umbrella column unit" is described. W. R. S.

265. The Modern Street Lighting Problem.

Anon. El. Rev., Vol. CXIX., No. 3073, p. 531, Oct. 16, 1936.

Describes, with photographs, a comparison between sodium-vapour, mercury-vapour, and incandescent tungsten systems of street lighting installation, which was made on a street at Canterbury. R. G. H.

266. Street Lighting.

Anon. Elect., 117, p. 462, Oct. 16, 1936.

Details are given of the present reorganisation of the lighting system of Birmingham. C. A. M.

267. Problems of Highway Lighting.

L. A. S. Wood. El. Journal, Vol. 33, No. 10, p. 459, Oct., 1936.

An article advocating adequate and continuous lighting for all main roads, to render headlights unnecessary. High road brightness is considered very desirable. Mounting height, spacing, lamp size, and light distribution are all considered. The sodium-vapour discharge lamp is suggested as suitable for lighting arterial roads, the mercury lamp for urban roads. R. G. H.

268. Sodium Lighting on Trunk Roads.

Anon. El. Times, 90, p. 485, Oct. 8, 1936.

A photograph and description of sodium lighting at Purley Way, Croydon. W. R. S.

269. Research and Measurement on Stereoscopic Projection, Using Polarised Light.

M. von Ardenne. Zeits f. Techn. Physik, 10, pp. 332-337.

A comprehensive account of the possible use of polarised light for obtaining stereoscopic effects. Photographs and diagrams are used to explain the text. W. R. S.

270. Kincardine-on-Forth Bridge.

S. A. G. Emms and D. C. Rogerson. G.E.C. Journal VII., No. 4, p. 248, Nov., 1936.

A description is given of the lighting equipment of the new swing bridge at Kincardine-on-Forth. C. A. M.

271. Swimming Pools.

Anon. Elect., 117, pp. 550-551, Oct. 30, 1936.

Photographs, with details of the lighting equipment of two open-air swimming-pools are given. C. A. M.

272. Newburgh Skates on Illuminated Track.

Walter H. Doyle. El. World, 106, p. 3188. Oct. 10, 1936.

Details are given of the lighting of a skating track 800 ft. in circumference. S. S. B.

Recent Patents

(Abstracts of recent Patents on Illumination & Photometry.)

No. 450,552. "Improvements in or Relating to Electric Arc Electrodes."

Moore, Wm. G., and Hole, K. W. Dated January 19, 1935.

This specification describes various compositions for electric arc electrodes giving an intense, fairly uniform, and extended spectrum comprising a sintered mixture containing a preponderating amount of tungsten, together with titanium and iron.

No. 452,191. "Improvements in and Relating to Electric Lamps."

The British Thomson-Houston Company, Limited. January 24, 1935. (Convention, U.S.A.)

According to this specification, an electric lamp bulb, such as a tubular bulb, is provided with a base having an annular central depression, increasing in diameter towards the interior. This base may be metallic and form one lamp contact, the other passing through it and being insulated therefrom. The holder for such a lamp may comprise prongs, which enter the depression and grip it. The holders may be of very short length, and thus a number of tubular lamps may be assembled in alignment with very small intervening spaces.

No. 452,501. "Improvements in or Relating to Reflectors for Lamps."

The Wardle Engineering Company, Limited, and Hopwood, E. E. November 15, 1934.

According to this specification a reflector for use with elongated light sources comprises concave reflecting surfaces, cylindrical reflecting surfaces and other reflecting surfaces, which are concave and convex in planes normal to each other, all so arranged as to provide two composite beams having their maxima at an angle less than 180° apart on opposite sides of the lamp. The concave reflecting surface may be a paraboloid having its axis of rotation in a plane normal to the light source column and the cylindrical reflecting surface may be concave, and may meet the paraboloidal surface in a transverse plane normal to the luminous column to redirect the light from the centre of the column. The third reflecting surface mentioned continues from the second surface and is concave, curves inwards towards the vertical plane in which the luminous column lies and is convex in planes normal to that plane. This third surface redirects light from the front-end portion of the luminous column.

No. 452,933. "Improvements in Aircraft Landing Lights."

The General Electric Company, Limited, Damant, E. L. B., and Villiers, W. A. March 26, 1935.

Apparatus for floodlighting aircraft landing grounds of the kind which projects fan-shaped beams of light of small divergence in vertical planes and of large divergence in horizontal planes is, according to this specification, arranged to tilt its beam of safe maximum divergence about a horizontal axis inclined at some angle less than 90° to the longitudinal axis of the beam into a plane inclined to the horizontal so as to direct substantially more than half of the beam above the horizontal axis (for example, the beam is tilted about one of its edges), and the apparatus is arranged to rotate the beam so tilted continuously or intermittently about a vertical axis so as to act as a flashing beacon. The tilting of the beam may be effected by tilting an optical system of mirrors or the like.

No. 453,268. "Improvements in or Relating to Portable Electric Lamps."

Maurice, W., and Wolf Safety Lamp (Hiring) Company, Limited. April 24, 1936.

This invention relates to portable lamps, such as miners' lamps, and describes an arrangement of lamp comprising a casing, a reflector, and a front glass in which spring-finger contacts extend through apertures in the reflector and engage end-contact caps of a tubular lamp bulb. The fingers are insulated against accidental contact with the reflector at the sides and back, but are only partially insulated at the front, so that they will make contact with the reflector when a lamp bulb is not in position. Thus, if the lamp should be displaced in service, the fingers will make contact with the reflector and cause a short circuit, thus blowing a fuse and eliminating any risk of sparking in the reflector part of the lamp.

No. 453,446. "Improvements in Electric Circuit Arrangements for Supplying Luminous Electric Discharge Devices."

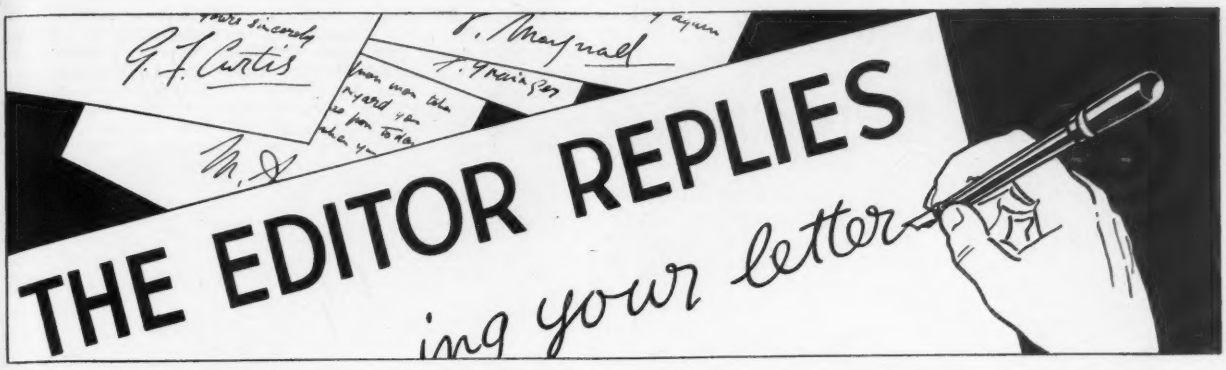
The General Electric Company, Limited (communicated by Patent-Treuhard Gesellschaft für Elektrische Gluhlampen m.b.H.). April 6, 1935.

In order to minimise the flicker of luminous discharge lamps when supplied by alternating current due to extinction of the lamp at the zeros of the alternations, the supply circuit comprises means for superposing on the alternating supply voltage an impulsive voltage, of which the peaks occur in the zero intervals of the alternating supply. The impulsive voltage may be generated by the starting or stopping of a discharge in a discharge device connected with the primary of a transformer, of which the secondary is connected to the luminous discharge device.

No. 454,116. "Improvements in Supply Arrangements for Luminous Electric Discharge Tubes."

The General Electric Company, Limited (communicated by Patent-Treuhard Gesellschaft für Elektrische Gluhlampen m.b.H.). July 25, 1935.

This specification relates to supply and switching arrangements for numbers of high-voltage luminous electric discharge tubes. The electric discharge tubes are supplied through thermionic diodes respectively connected in series with the several discharge tubes, and independent switching means is provided for controlling the cathode temperatures of the diodes. Switching-off of any particular discharge tube is effected by cooling the cathode of the diode connected in series with it.



Well—There's a Lot to be Said on Both *Sides.*

We are occasionally asked where **books on lighting and photometry** can be be seen and studied. The Illuminating Engineering Society hopes some day to have a special library for the use of members, but for the moment it has only a small nucleus of books, some possessed and some promised. The **Patent Office Library** (Southampton Buildings, Chancery-lane, London), to which the public has free access, has the signal advantage of being open in the evenings. There is quite a useful collection of books on light and lighting, and the collection of technical journals is doubtless one of the best available in London from the standpoint of our readers.

The question has been put, "Why are there so few **lighting consultants?**" This point was recently emphasised in Mr. Cunnington's presidential address. It is a fact that one scarcely knows where to look for men who have both the full technical qualifications and the impartial position to advise as "illuminating engineers."

One explanation is that, for the time being, the lighting expert who desires to make a living must have other strings to his bow. The ultimate solution of the problem lies in public education in the benefits of good lighting. Government departments, local authorities, railways, and large industrial organisations could all make good use of specialists in illumination. If they could be induced to do so the demand for the consultant would also develop.

We have been asked to say something on the comparative visual advantages of **sodium and mercury vapour lamps.** We confess that we are reluctant to do so, because any views we may hold are necessarily based largely on personal impressions, and it is extraordinary how such impressions seem to depend upon the peculiarities of the individual eye.

A useful opportunity of comparing notes was afforded recently at Cheltenham, where, at a fork in the road, mercury lighting could be seen on one side and sodium on the other. One was struck by the variety of views expressed, but one need not wonder at this when it is considered how such qualities as apparent "sharpness" of outline and contrast depend not merely on the chromatic aberration of the eye, but the influence of this quality in conjunction with other visual lens defects—quite apart from such complex physiological factors as those discussed by Professor G. B. Van der Werfhorst on that occasion!

We have also noticed marked difference in regard to **susceptibility to glare,** though in this case it is a matter of *degree,* rather than *conflict* of impression. Some people seem strangely insensitive. We can recall the case of an old sea captain whose eyes had no doubt become hardened by a lifetime of gazing over the glittering sea. It was reported that he could look straight into an arc light from a distance of a few feet—and read small print immediately afterwards. It was, not unnaturally, difficult to convince him that any artificial lighting installation was unduly glaring!

The writer himself leans towards mild and soft systems of lighting. The majority of street-lighting installations he finds in some degree distressing owing to glare. There are, however, others who seem even more sensitive. In all such cases, therefore, it seems expedient to ascertain "the middle view."

We have been asked whether there is any **legal standard of lighting** in factories. Mr. Murray, in his recent I.E.S. paper, has pointed out that adequate and suitable lighting is required in certain specified trades. There is, however, at present no *general* statutory requirement of adequate and suitable lighting in the Factory Acts—though this was recommended more than twenty years ago. There is some hope, however, that some such requirement may be embodied in forthcoming legislation.

A letter from Mr. T. N. Riley deals with the problem of the **grumble point** and the application of photo-electric cells to control the switching on of artificial light. He points out that the cell responds only to the illumination on the spot where it is placed, whereas the eye roves from the task on which it is occupied and is subject to external influences. It is, for instance, influenced by the window, usually the brightest object in the field of vision. The grumble point is therefore probably higher on a bright day than on a dull one, and on days when the brightness is variable it tends towards the higher value. Similarly, the minimum for comfortable reading might be different for indirect lighting than for an installation with a certain amount of glare. It is, he suggests, irrational to specify a certain level of illumination without consideration of other relevant factors.

A cutting expressing the views of a lady described as the "Diamond Queen" on **lighting for jewels** has been sent to us. It is stated that this lady, an expert, will make no purchases under artificial light—indeed, she abandons her search even in daylight if the sky is dull.

She may be wise. The expert in hunting jewels cannot always expect the stones to be brought to him (or her), but may have to examine them in places where only poor artificial light is available. Jewellers in general are said to prefer daylight. It does not follow that *they* are wise, however, for they can, if they choose, install the most perfect artificial lighting available. And we find it difficult to believe that artificial light, properly controlled in regard to colour, intensity, and diffusion, cannot do everything that daylight can do in this connection.

Lighting Work—Temporary Post Offered

AN opportunity for temporary work in connection with Industrial Lighting and Street Lighting Installations is presented in connection with a Government Department. Young men qualified to deal with lighting problems and willing to serve on a temporary basis are invited to submit applications, giving particulars of qualifications and salary required, to Box 461, "Light and Lighting," 32, Victoria-street, London, S.W.1.

CORRESPONDENCE

Light in Daily Life

We have been requested to present in full the following letter, which was the subject of comment in our last issue (November, 1936, page 349). In view of the exceptional interest of the topic, and in order to illustrate our policy of affording opportunity for the expression of all shades of opinion, we have decided to accede to the request on this occasion, and to depart from our usual rule of handling correspondence in brief in "The Editor Replies."

Sir,

The long unsigned article on "Light in Daily Life" in your October issue contains much interesting and instructive matter, but also a good many questionable statements on which I should like to make a few comments.

The writer of the article expresses doubt whether the increasing use of glasses really indicates a general deterioration of eyesight in recent years. It is obvious, of course, that before spectacles were invented or became generally available they couldn't have been worn, although doubtless there were people with defective sight; but I think it is obvious that the very rapid and noticeable increase during the last thirty years or so in the number of people wearing glasses cannot be attributed merely or mainly to increasing facilities for treatment and provision of glasses. If there have always been as many people with bad sight as are now wearing glasses, it is difficult to see how the enormous industrial expansion and scientific advances of the last century could have taken place with so many persons of all classes unable to see clearly.

Your contributor writes as though reading were the only form of close work, and suggests that if our "ancestors" rarely needed glasses it was because they seldom read. But what about the fine tapestry and embroidery work, the watchmaking, jewellery, and fine filigree work, the etchings, woodcuts, and fine carving, and innumerable other forms of fine arts and crafts that were followed much more extensively than now? And why dismiss the "clerks," who did read habitually, as "a race apart"? Presumably they were human like the rest of our "forefathers," but I do not think that a large proportion of them used or needed glasses. Indeed, there were large communities of "clerks" long before the thirteenth century, when spectacles were first invented.

However, I think it is more instructive to compare present conditions with the earlier days of the Industrial Revolution, when a great deal of close work was done in many industries and occupations, such as textile mills, weaving, etc., drawings and tracings in connection with shipbuilding, locomotive works, etc., fine tool work, fine work by seamstresses, etc. Hours were much longer as a rule than nowadays, and much more overtime was done; also foggy days were more frequent, necessitating long hours of work by artificial light even in daytime. Moreover, education was already pretty general, and most people could read, and did read, in their spare time—if they had any! On the whole, I do not think there is very much more fine or close work now than, say, thirty or fifty years ago, although many new kinds of fine work have arisen in recent years.

I think, therefore, that the increasing use of glasses obviously indicates increasing eyestrain among the population, and this increase rather strikingly coincides with the increasing use of electric light and the use of increasing intensities in artificial lighting. I remember when electric lighting was introduced at the Rover works in Coventry many of the older workers found the change a strain on their sight, and wanted to go back to gas. I also recollect the more recent case of a Cambridge clergyman who experimented with 25, 40, 60, and 100 watt lamps in his new diffusing fitting, and found that he could read for much longer periods without eyestrain by the 25 watt lamp than with any of the others.

I could give many more examples of a similar kind, all of which tend to show that much of the increasing eyestrain of recent years is due to (1) the more unnatural quality of uncorrected electric light and (2) the increasing use of unnecessarily high intensities of such uncorrected light.

Your contributor admits that the human eye has been evolved for the use of daylight or "natural" light, but he wants to "correct the supposition that there is some radical difference *in kind* between natural and artificial light, and that the latter contains mysterious ingredients or noxious rays which are positively injurious to the eyes." Personally, I have never met with such a supposition, but, on the contrary, find it all too commonly assumed that there is *no* difference of any importance between natural and artificial light, and I consider it very desirable to educate users of electric and other artificial light to realise that, while it contains most of the "rays" or wavelengths present in daylight, they are present in very different proportions in artificial light. For example, electric light has a great preponderance of red, yellow, and orange rays, and a relative deficiency of violet and blue, as compared with daylight. The human eye is not naturally adapted for this disproportion of wavelengths, and in view of this it is important to avoid both glare *and unnecessary intensity*. At the same time it is desirable to correct the light by means of filters, etc., so as to obtain a closer approximation to daylight whenever this is possible, though under present conditions this is frequently ruled out by economic considerations.

It is difficult to see what useful object is served by the diagrams indicating the high intensities of June sunlight ranging from 10,000 to 200 foot-candles and comparing them with the 5 foot-candles of artificial light said to be common in living-rooms. Surely it is obvious that we do not require anything like full daylight to see comfortably, and who wants to read out of doors in sunlight? When we have to do so we find it painfully dazzling, and we make for the shade and preferably go indoors. Moreover, the diagrams and the article omit to mention that daylight varies twice every day from zero to noon sunlight, and that we can see quite comfortably to read out of doors at dawn and twilight or with the sky heavily overcast, when the intensity is as low as, or lower than, that of most artificial lighting.

As a matter of fact, the figure of 5 foot-candles is unnecessarily high for general indoor lighting, 3 foot-candles being ample, provided the light is well diffused and evenly distributed.

Probably your contributor and the compilers of the diagrams have fallen into the error of assuming that the sole function of the sun is to provide us with illumination, and that if it provides 10,000 foot-candles, that must be the ideal intensity for us to see by. However, the sun is primarily the source of power, heat, and life itself, and we therefore have to take the corresponding flow of light which is poured out in such superabundance. Nature herself provides clouds to mitigate the intensity of the light and a green carpet over the habitable parts of the earth to absorb a large proportion of the light, also trees and forests in which to shelter from its excessive intensity, and we find no difficulty in seeing our surroundings or reading even in dense woods by daylight.

Surely the only sensible test of the right intensity for artificial lighting is whether we can, in fact, see clearly and comfortably by it. If so, why increase the intensity just because we have much greater intensity than we need in daylight? If we could accurately reproduce the colour and diffusion of daylight in our artificial lighting, probably we could safely use much higher intensities than are actually necessary for good vision, but as both the colour and distribution of artificial light necessarily fall short of daylight, we only incur the danger of ultimate injury to our sight by using higher intensities than we need, besides incurring unnecessary expense.

What I do think it necessary to advocate is increasing attention to diffusion with a view to approximating to the even distribution of daylight due to innumerable reflections, and re-reflections in all directions, and, where possible, to colour correction with a view to reproducing the wavelength constitution of daylight as closely as possible.

Hence, while your contributor places the chief differences between natural and artificial light in the following order of importance: (1) Intensity, (2) constancy, (3) diffusion, (4) colour, I suggest that the order should be almost reversed, as follows: (1) Diffusion, (2) colour, (3) and (4) intensity and constancy, the two latter being of no importance whatever, since daylight varies over an enormous range of intensity and is very inconstant, and our eyes being used to such variations, we can adopt any intensity which is found adequate in practice for seeing clearly and easily, provided we can obtain similar conditions of diffusion and colour, while we already have the advantage of constancy with artificial light.—I am, Sir, yours faithfully,

G. V. DOWNER.

Public Lighting in Southport

A Correction

We have been requested by Mr. J. Herbert Clegg, the engineer and manager of the Southport Gas Department, to correct a statement in our October issue (p. 326) to the effect that a number of important roads in Southport have been converted to electric discharge lamps. We are informed that only one such installation, comprising about eight lamps, has been installed for nearly three years. We regret the oversight to which Mr. Clegg has drawn our attention.

The BTH "DILEN" Lantern is the most up-to-date and efficient unit of its type yet designed for the lighting of streets where side mounting is required.

Here are some of its salient points:—

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Interior prisms of bowl so arranged as to give maximum brightness distribution on road surface.

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Lamp Suspension Gear for Modern Electric Lighting

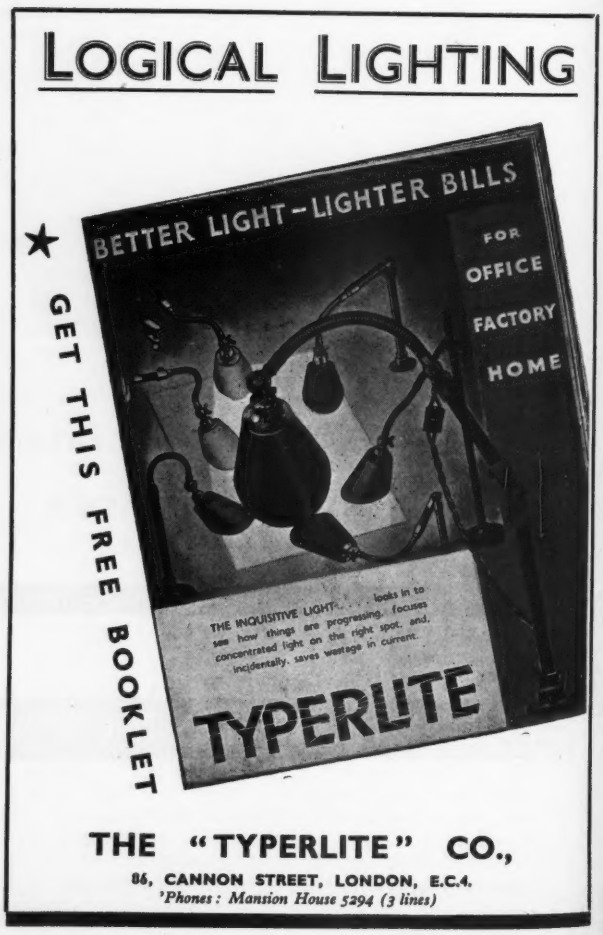
A useful illustrated booklet is issued by Walter Slingsby and Co., Ltd., of Keighley, illustrating their "Wask" patent "Up and Down" Lamp Suspenders for electric street lamps. With a modification of the swivel joints this resembles the gear used for raising and lowering gas lamps previously introduced by the firm which has proved very successful. (We hear that an order for the equipment of 1,000 gas lamps at Cambridge has just been completed and that another 350 gears are being supplied to Hendon).

The electrical gear is likely to prove specially useful for electric discharge lamps in view of the advantage it confers of raising and lowering the lamp with undisturbed contacts. The apparatus, which is fully illustrated and explained in the leaflet, has been thoroughly tested prior to introduction, so that users may be confident that this is a practical job.

Neon Window Units for the Coronation

Special Neon signs for shop window use in connection with the Coronation are being made by Neon Manufacturers, Ltd., Regent House, Kingsway, W.C.2, in a variety of shapes and sizes to the individual requirements of customers.

In addition, they make a standard range of Coronation Units. Two illustrations before us show models utilising a golden plaque of the King's head surmounted by a crown and outlined in Neon tubing in red, white, and blue. A transformer is fitted in the base of each, so that it can be plugged into any suitable lighting point.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Note the Vitreosil Test. Only Vitreosil Lighting Ware survives this ordeal. Any other lighting glassware, even though it passes the British Standard Specification Test, would be shattered by the shock of sudden cooling from red heat. This means a margin of safety far in excess of the needs of domestic or industrial lighting. It enables Vitreosil Globes, Bowls and Reflectors to be used on high-pressure and super-heated burners without the slightest fear of "flying."

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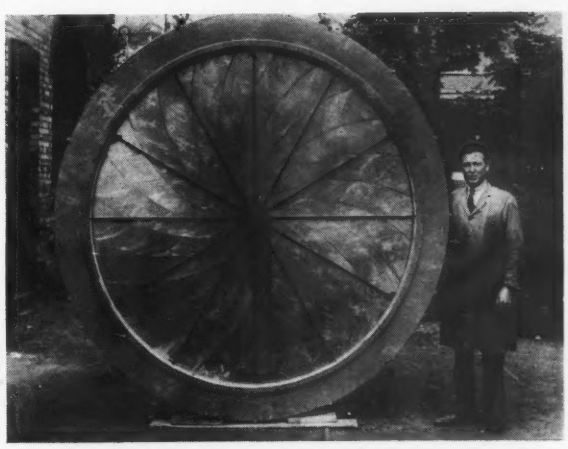
The Largest Iris Shutter in the World

This is the description of the iris shutter shown in the adjacent picture, the aperture of which is 80 in. in diameter. The London Electric Firm, in sending us this information, state that the vanes of a shutter of this kind move from the periphery to the centre, in somewhat the same manner as the small diaphragms used with photographic lenses, but the mechanism is more refined. Every effort has been made to eliminate friction, and the driving ring which operates the vanes runs in ball-bearing rollers. Arrangements are made whereby the shutter can be operated electrically from a distance but it can also be worked locally by hand if desired. Mechanical dampers come into action as the shutter opens or closes, so that no impact reaches the vanes. A special trip switch can be fitted to light a signal lamp to indicate closure, or otherwise, of the shutter.



An Iris Shutter, 80 inches in diameter, recently constructed by the London Electric Firm, Croydon—stated to be the largest in the world.

Novel Table Standards

A series of loose sheets received from Siemens Electric Lamps and Supplies, Ltd., illustrate pleasing new types of table standards. We also notice a new "all insulated" bathroom fitting, with bakelite lampholder and opal globe, which seems very moderate in price.

Contracts Closed

THE BRITISH THOMSON-HOUSTON CO., LTD.

Port of London Authority—For the supply of Mazda Lamps for the twelve months ending October, 1937.

Sodium and Mercury Lighting Compared

An interesting sight at the A.P.L.E. Cheltenham Conference was afforded at the point where a main road forked and the lighting with sodium lamps on the right could be compared with the light of mercury lamps installed on the left. Something rather similar is effected in the new Revo catalogue. Several pages contain pictures prepared from photographs of installations of mercury electric discharge lamps, executed in a pale greenish colour resembling the actual effect, and, opposite to them, similar views of sodium installations printed in orange. The impression is quite life-like. One can thus compare, say, Egham Hill (mercury) with Osmaston-road, Derby (sodium). Viewing the pictures from some little distance helps to preserve the illusion that one is looking at an actual street.

An Apology.

We tender sincere apologies to those customers who have been disappointed by the delay which has occurred in the delivery of Newbridge Clock Controllers, owing to the recent unprecedented demand.

During the past few months our output of Controllers has exceeded all previous records. We are now in a better position to cope with orders, and arrangements presently in progress will enable us to increase our production still further for next lighting season.

We have also experienced a record demand for Newbridge Gas Switches, Gas Pistols and Comets, but, in the case of these products, arrangements made at the beginning of the year, in anticipation of this increased demand, have enabled us to effect deliveries without undue delay.

We take this opportunity of thanking our customers, both old and new, who have entrusted us with their business, and assure them that every possible effort is being made to meet their requirements.

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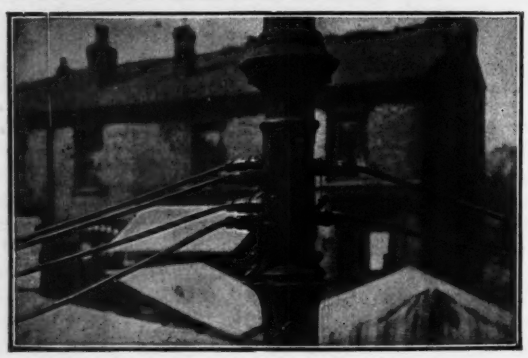
Sales of Gas in 1935

The B.O.T. returns relating to gas undertakings (a total of 718 in England, Scotland, and Wales) reveal that nearly 295,857,000,000 cubic feet of gas were sold in 1935, a record figure, and 1.8 per cent. over 1934. The number of consumers was also up by 2.3 per cent., making a total of 10,516,759. It is interesting to note that the cubic feet of gas sold for public lighting have, with one exception, increased annually since 1920, and have since practically doubled, being now over 13,000,000,000. In ten years 16,000 miles of additional gas mains have been laid, raising the total to 59,000.

Gas Lighting in Nottingham

The above picture shows some of the new gas lighting in the streets of Nottingham which has been installed on many 'bus routes. On one of the main approaches to the site of Nottingham's famous Goose Fair, forty lamps, chiefly 3-light burners on 10 ft. 6 in. columns, have been replaced by sixty-one 6-light gas lamps fitted with directional reflectors and mounted on 12 ft. 6 in. columns, giving a total mounting height of fifteen feet. The new lighting is in accordance with Class F of the British Standard Specification.



A "Niphan" market lighting installation, showing main feeding sockets fitted to a lamp standard.

MARKET LIGHTING with the NIPHAN System

FOR some years we have been collaborating with public lighting authorities in devising temporary lighting installations for market stalls. The picture shows part of a "NIPHAN" market job, in which 6 sockets, in conjunction with a fuse board, were mounted on a lamp standard, with plugs leading to 3-way tees and suspended through sockets.

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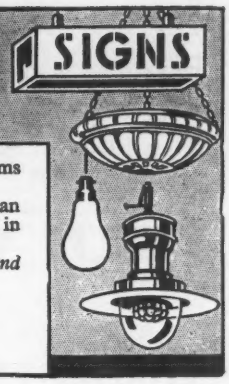

We invite applications for spaces in this new section of the journal. Particulars of terms for each space (approx. 1 inch deep and 3¼ inches wide) are given below.

These terms are equivalent to **half our ordinary advertising rates**, but not less than 12 successive monthly insertions can be accepted on this basis, and amounts are payable in advance.

Payment for an advertisement in this section entitles the advertiser to receive *Light and Lighting* during the period of the contract.

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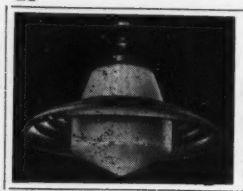

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HEATING AND AIR CONDITIONING OF BUILDINGS. By Oscar Faber and J. R. Kell. (The Architectural Press, Westminster.)

ÉTUDE DE L'EFFICACITÉ DES PROJECTEURS AU TRAVERS D'ATMOSPHÈRES NON LIMPIDES. By Alfred Monnier. (Sauvion et Lelièvre, Paris.)

RECHERCHES SUR LES PROPRIÉTÉS PHYSIQUES ET LES EFFETS PHYSIOLOGIQUES D'UNE LUMIÈRE COLORÉE. By Marcel Mouton. (Sauvion et Lelièvre, Paris.)

MODERN CINEMAS. (The Architectural Press, Westminster.)

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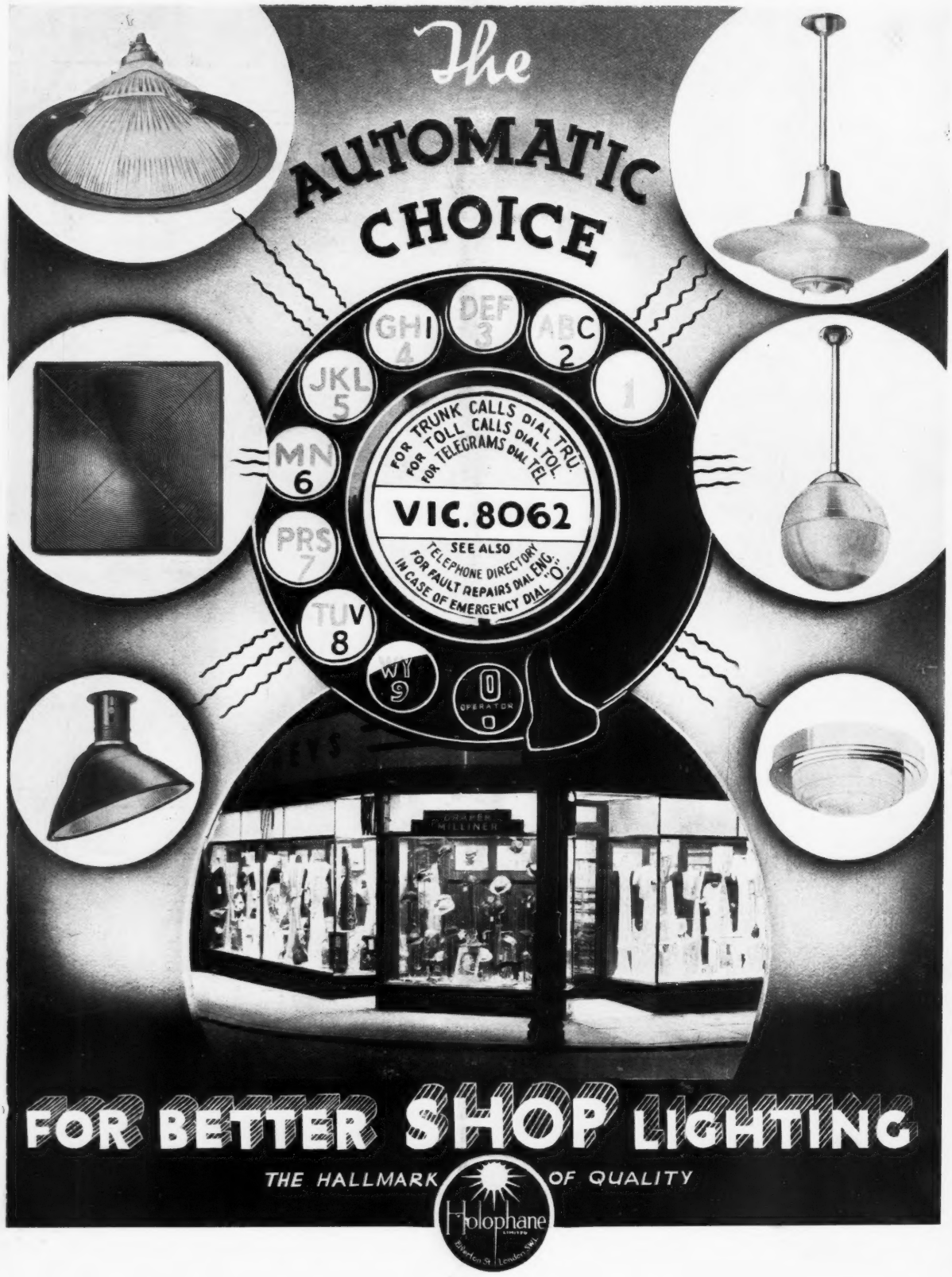

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